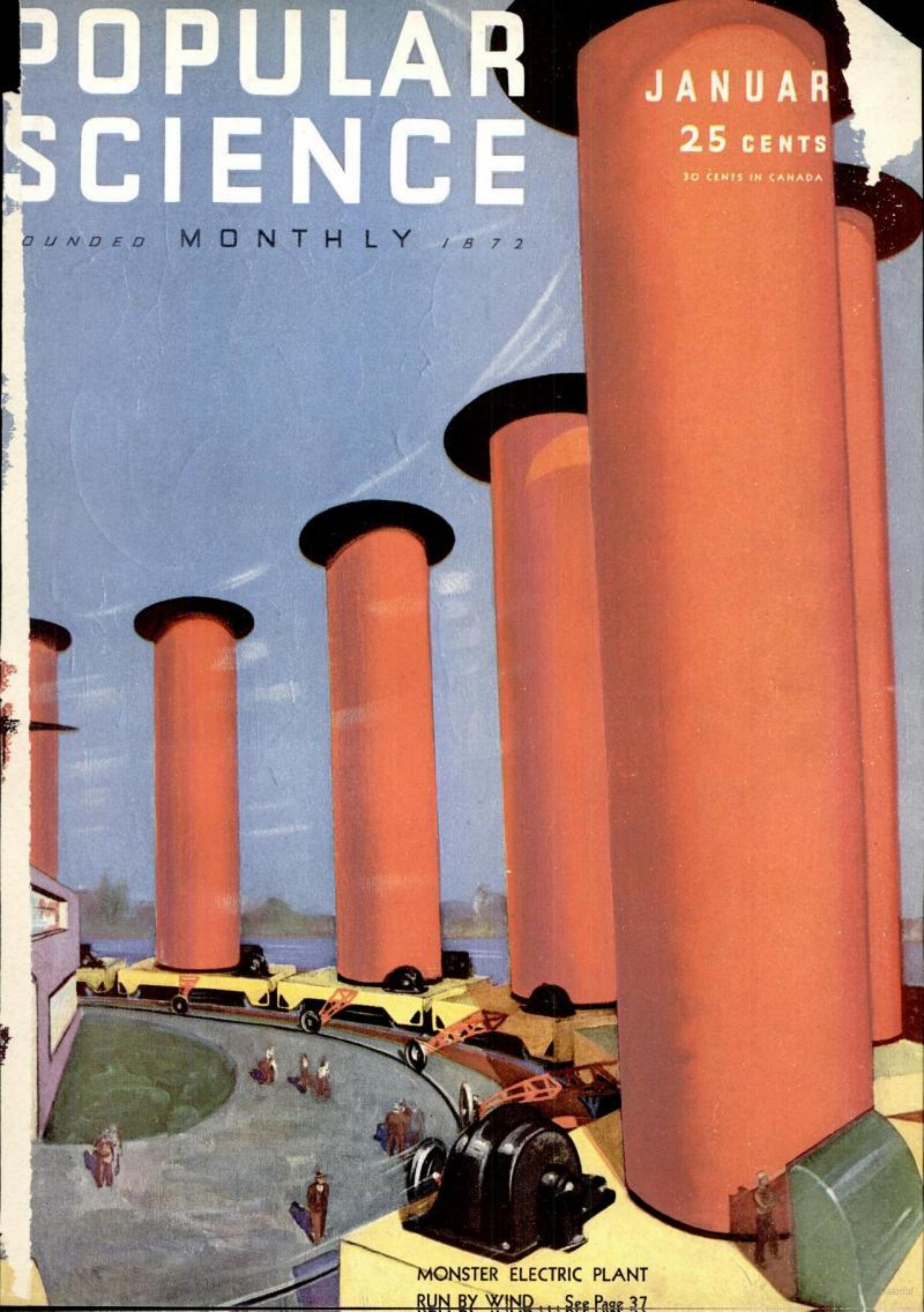
POPULAR SCIENCE

FOUNDED MONTHLY 1872

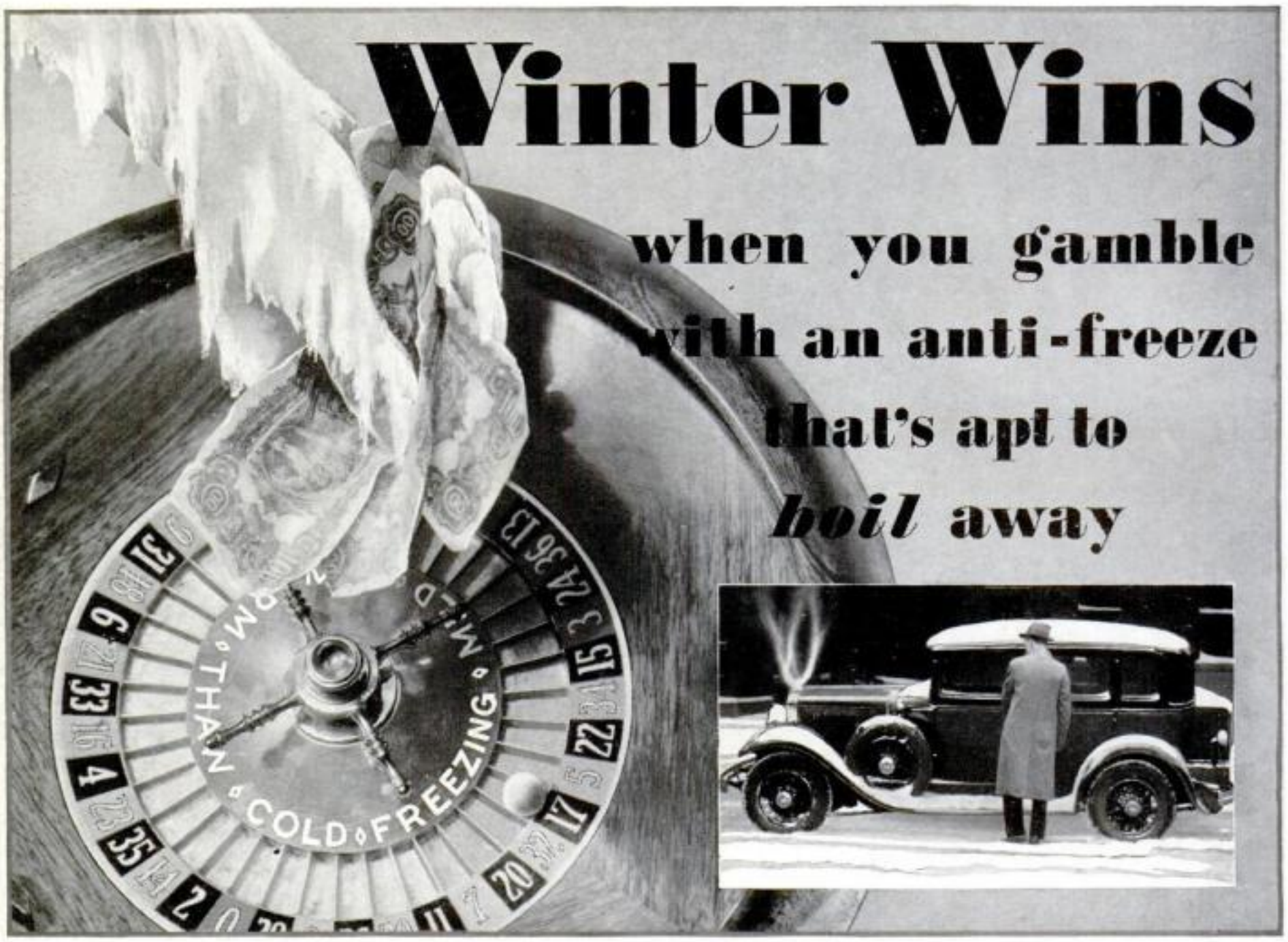
JANUAR

25 CENTS

30 CENTS IN CANADA



MONSTER ELECTRIC PLANT
RUN BY WIND ... See Page 37



GAMBLING with makeshift anti-freezes is a dangerous game. You can't outguess Old Man Winter. But there's one thing you can be sure of. There will be mild days this winter, and there will be cold ones. If you use an anti-freeze that's apt to boil away on the mild days, you're risking a frozen automobile—and a heavy bill for engine repairs—when the cold snaps come!

There's one anti-freeze that won't boil away. That's Eveready Prestone, the product that was scientifically developed to keep automobile-engines from freezing. It flows freely at zero, yet it will not overheat your engine. It does not decompose at high engine-temperatures, and gum up your cooling-system. It has less tendency to leak than water.

Always supreme, Eveready Prestone is this year still further improved. It actually forms a protective film over the rough metals of your radiator, retards the formation of rust, and keeps the whole cooling-system unclogged and free-flowing. It is accepted by leading car manufacturers and automotive engineers. Last year more than a million and a half motorists used it to end winter-worry!

Consider the cost per season, not per gallon, and you will know why Eveready Prestone is economical. It is concentrated, and only a relatively small quantity is needed. With it there is no worrying, no constant testing, no danger of a frozen engine. Don't gamble with makeshift products. Don't wait for winter to pounce on your car. Have your radiator cleaned, tightened and filled with the proper amount of Eveready Prestone.

NATIONAL CARBON COMPANY, INC.
General Offices: New York, N. Y.
Unit of Union Carbide UCC *and Carbon Corporation*

9 POINTS OF SUPERIORITY

1. Gives complete protection.
2. Does not boil off.
3. Positively will not damage cooling-system.
4. Will not heat-up a motor.
5. Circulates freely at the lowest operating temperatures.
6. Will not affect paint, varnish or lacquer finishes.
7. Non-inflammable and odorless.
8. Prevents formation of rust in cooling-system.
9. Economical—one filling lasts all winter.

EVEREADY PRESTONE

Write for free copy of Eveready Prestone Manual . . . prepared by cooling-system engineers and which contains semi-technical information about this remarkable anti-freeze.

NOTE: *When you drain your cooling-system of Eveready Prestone in the spring, put in Eveready* RUSTONE, *for all-summer protection against rust, clogging and overheating. Then your car will always be free of rust.*

Copyrighted material

Boys! $75,000 IN AWARDS . .

State Winners at Guild Convention Banquet in Detroit

FISHER BODY CRAFTSMAN'S GUILD OFFERS 4 UNIVERSITY SCHOLARSHIPS OF 4 YEARS EACH AND 1120 OTHER AWARDS

International Awards: Four University Scholarships of Four Years Each—two of these Scholarships go to Juniors (12 to 15 years inclusive) and two go to Seniors (16 to 19 years inclusive).

TEN AWARDS FOR SENIORS AND TEN AWARDS FOR JUNIORS in Every State and Canadian Guild District as Follows:

1st State or District Award—Trip to Detroit and	$100 in gold
2nd State or District Award	$100 in gold
1st State or District Woodcraft	$25 in gold
2nd State or District Woodcraft	$15 in gold
1st State or District Metalcraft	$25 in gold
2nd State or District Metalcraft	$15 in gold
1st State or District Trimcraft	$25 in gold
2nd State or District Trimcraft	$15 in gold
1st State or District Paintcraft	$25 in gold
2nd State or District Paintcraft	$15 in gold

Every Guild member who submits a completed coach on or before midnight, July 1, 1932, will receive the Guild Certificate of Craftsmanship.

Don't Delay . . . . Enroll Today

There are no fees nor dues. As soon as enrollment is received at Guild Headquarters, complete plans and information on how to build a miniature model Napoleonic coach will be sent free of charge. You can enroll through your manual training teacher, your Scoutmaster, your Y. M. C. A. leader, or direct through any dealer in General Motors cars, Cadillac-LaSalle, Buick, Oldsmobile, Oakland-Pontiac, and Chevrolet.

FISHER BODY CRAFTSMAN'S GUILD

Guild Headquarters: General Motors Building, Detroit, Michigan. Canadian Section, Oshawa, Ontario, Canada

Copyrighted material

25 Cents a Copy
$2.50 a Year

POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

Table of Contents for January, 1932

LEADING ARTICLES

FEATURES AND DEPARTMENTS

AVIATION

AUTOMOBILES

HEALTH AND HYGIENE

LABORATORY DISCOVERIES

January, 1932. Vol. 120, No. 1. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1931, by the Popular Science Publishing Co., Inc. Single copy, 25 cents (30 cents in Canada). Nine months' subscription in U. S., $2. Yearly subscriptions to United States and its possessions, $2.50; foreign countries, including Canada, $3. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Secretary.

Copyrighted material

Popular Science Monthly for January, 1932

MODELS

NEW PROCESSES AND INVENTIONS

RADIO

SHIPS

UNUSUAL FACTS AND IDEAS

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

Copyrighted material

HERE'S *light* ON THE GREAT ANNUAL PROBLEM

New, unusual, and useful gifts . . . Eveready *Wireless-Electric* Lights! Almost everybody has dim, dark closets, corners, and out-buildings that can't be conveniently wired for electric light.

Eveready *Wireless-Electric* Lights don't need wires! Use them anywhere; any time. Each light is reliably powered by the *new* Eveready *extra long life*, metal-seal Batteries that give many hours of bright light. A set of renewal batteries costs only twenty cents.

THE EVEREADY WALLITE

Beautifully finished in black or ivory, with polished, lacquered brass trimmings. 4½ inches wide; 5¼ inches high. Operates with a handy pull-chain. Can be put permanently in place; or hung on a nail or hook — free to be carried anywhere. Closets, garages, cellars, attics, and back-porch steps are only a few places where Wallites are often needed.

THE EVEREADY ELECTRIC CANDLE

Six and three-quarter inches high. Handsome, silvery finish. Lights when you pick it up. Goes out when you put it down. A steady, permanent light is also possible. The Candle is easily found in the dark by the little luminous dots at the base. Ribbon marking on case covered by trade-mark.

There are a dozen spots where Eveready Candles are a necessity. . . . Telephone-stands, book-cases, dressing, dinner, and bedside tables are only a few.

You probably know your friends' homes pretty well, and know where they could use Eveready *Wireless-Electric* Lights. Only $1.75, complete, each. At all good hardware, drug, electrical, department, auto-accessory and gift stores.

EVEREADY *WIRELESS-ELECTRIC* **LIGHT**

NATIONAL CARBON COMPANY, Inc.
***General Offices:* New York, N. Y.**
Unit of Union Carbide UCC *and Carbon Corporation*

How to Read An Earnings Statement

By LEON MEADOW, *Financial Editor*

"SAY, Walter," said Fred Hobart, Advertising Manager of the Ajax Publishing Company, "remember the lecture you gave me some months ago on how to read a balance sheet?" (P.S.M., Oct. '31, p. 4).

The two men were seated in Walter Barnett's office one evening, after business hours, and Barnett, the accountant for the company, replied: "I certainly do—and I also remember that the balance sheet of the General Sample Company showed a very favorable position in regard to their bonds and preferred stocks. Did you buy any?"

"No, I didn't," Hobart answered, "though not because I thought your advice unsound, but because you need money, even these days, to buy anything—and money is the 'thing I have least of'!"

Walter smiled. "That puts us both in the same boat. But what's bothering you now?"

"Nothing much. I just ran across an earnings statement for this same company, and I thought if you weren't busy, you might like to show me how to analyze it. You mentioned something, last time we talked, about the importance of an earnings statement in determining the financial position of a company—so I'd like to know more about it. That's all."

"I'll be glad to do that for you, Fred. Have you got the statement with you?" Hobart nodded and handed it over.

Walter glanced at it, rapidly wrote down a number of figures on one side and then said, "It looks like a fairly typical example of a general earnings statement for a twelve months period—and that's just as well, because, as is the case with a balance sheet, the form and wording of an earnings statement depends on the character of the company and its business. A bank necessarily reports its earnings in an entirely different manner from a street car company or a department store. Fundamentally there are features common to all statements, and they all should reveal in greater or lesser detail the results obtained from the operation of a company's business—which means whether or not the company is making profits and, if so, how large they are, where they come from and where they go. The complete earnings statement should show all that, but most companies prefer to publish only a limited number of these details, doing so for the purpose of guarding certain trade and operating secrets—or for other reasons.

To proceed—the column marked 'Increase' is the one I put in myself, when you saw me writing on the statement. I did this to make it easier to see *(Continued on page 5)*

GENERAL SAMPLE COMPANY

Comparative Earnings Statement for the Twelve Months Ended December 31:

	1930	1929	Increase
Gross Sales	$2,140,510	$2,095,495	$ 45,015
Operating expenses (cost of materials, wages, rents, etc.)	1,892,766	1,743,320	149,446
Maintenance	23,415	21,517	1,898
Depreciation	6,500	6,400	100
Total Operating Expenses	1,922,681	1,771,237	151,444
Operating Income	217,829	324,258	x106,429
Other Income	14,312	2,305	12,007
Total Income	232,141	326,563	x94,422
Miscellaneous Interest	4,444	3,511	933
Interest on funded debt ($250,000 —6% 1st Mortgage Bonds and $25,000—7% Notes)	16,750	16,750	
Bond Discount & Expense	3,240	3,306	66
Total Fixed Charges	24,434	23,567	867
Net Income Before Income-taxes and Dividends	207,707	302,996	x95,289
Federal & Other Income-taxes	29,615	37,433	x 7,818
Net Income Available For Dividends and Surplus	178,092	265,563	x87,471
Preferred Dividends (on 2,000 7% Shares)	14,000	14,000	
Common Dividends (20,000 no par Shares)	120,000	160,000	x40,000
Balance to Surplus	44,092	91,563	x47,471
Fixed Charges Times Earned	9.5	13.8	
Outstanding Preferred Shares	2,000 shs	2,000 shs	
Outstanding Common Shares	20,000 shs	20,000 shs	
Earned per Preferred Share	$89.04	$132.78	
Earned per Common Share	$ 8.90	$ 12.58	

(x Decrease)

Copyrighted material

HOW TO READ AN EARNINGS STATEMENT

(Continued from page 4)

at a glance what amount of increase or decrease has taken place in each item, from 1929 to 1930.

"The first thing you see is that the company's gross sales show a small increase of $45,015 in 1930; however, this gain is more than offset by the increase in operating expenses, and consequently the operating income—or the difference between the two—for 1930 is considerably lower than it was in 1929. This increase in expenses could hardly be due to higher cost of raw materials or higher payrolls since these items were generally cheaper in 1930 than in 1929. However, it may be traced to new expenditures for experimental purposes and processes. To learn the actual causes you would have to go to a bank or investment council, for they might be able to get the information from the company.

" 'Maintenance,' or the cost of factory and equipment upkeep, and 'Depreciation' both reduce 1930's operating income, although only slightly more so than they did in 1929. Then comes a good increase in 'Other Income', meaning income derived from sources other than those of the Company's regular business."

"What would they be?" queried Fred.

"INCREASED interest received from bank balances or rental income from property leased to other enterprises or individuals. Added up, the total income for 1930 amounts to $232,141—or $94,422 less than it was in 1929. That means they have $94,422 less available for their fixed charges which, as you can see from the statement, includes $4,444 for interest on miscellaneous debts, and interest on the company's funded debt of $250,000—6% first mortgage bonds and $25,000—7% Notes—requiring a total of $16,750 yearly interest. Added to that is an item of $3,240 for 'Bond Discount & Expense'—which stands for the annual writing off of the difference between what the company received from the sale of its bonds to bankers and what it has to pay out to holders on the maturity of the bonds. So now, the net income drops still lower—to $207,707—or $95,289 less than it was in 1929.

"There is one more item to be deducted—'Federal and Other Income Taxes'. This amounts to $29,615, which is $7,818 less than it was in 1929—as it naturally would be, since the taxable income is smaller in 1930. The balance remaining is then $178,092, and this is the net income vailable for preferred and common dividends and surplus. Preferred dividends for the year on 2,000 shares of 7% stock takes $14,000, theoretically leaving $164,092 for the common stock dividends, or $8.20 per share. However, the directors saw fit to strengthen the surplus or reserve fund to the extent of an additional $44,092, actually leaving $120,000 for common dividends—or $6.00 a share on the 20,000 common shares.

"WELL, tell me—Walter, is that 1930 drop necessarily a cause for alarm?" asked Hobart.

"I'm coming to that. Now look at the item 'Fixed Charges, times earned', which is derived by dividing the total fixed charges into the total income—and primarily serves as a rule for determining the safety of the interest due on the company's bonds and other notes of indebtedness. In this case, the company did not do as well in 1930 as it did in 1929, having earned its fixed charges 9.5 times as against 13.8 times for these two years respectively. However, it still earned them by a wide margin—as the total income was almost ten *(Continued on page 6)*

...DON'T clip the coupon

(...*if you are over 55!*)

Since the first announcement of our new policy, the **Provident Providor,** we have been literally deluged with requests for information about this unique and comprehensive retirement plan . . . We do not want anyone to be disappointed. The **Provident Providor** is not offered to men over 55 or to women. We have other policies or annuity contracts more suitable to their needs. Nor is the **Providor** available to men in poor health or hazardous occupations. It is distinctly a selective contract, and those who obtain it get the full advantage of this selection. Here's what the **Provident Providor** guarantees to pay:

IT WILL PAY

$100 A MONTH commencing at age 65 and continuing as long as you live. A cash sum may be taken instead if you prefer.

$10,000 IN CASH to your family in case you should die before reaching age 65. An income for life may be substituted if desired.

$20,000 IN CASH, or double the face amount of the policy, to your family in case death results from accidental cause before age 65.

A HELPFUL PROVISION. The difficulty with most savings plans is that they come to an end in case you are disabled. The **Provident Providor** overcomes this handicap by guaranteeing to pay all premiums for you during prolonged total disability which occurs before the age specified in the contract.

FOR MARRIED MEN

The **Provident Providor** will take care of you and your wife if you live; it will take care of your wife if you do not. An especially attractive feature of the **Providor** is that you may select a somewhat reduced income at age 65 with the guarantee that the Company will pay an income to your wife and yourself as long as either shall live.

. . .

TODAY let us send you our booklet describing this increasingly popular contract. Just clip the coupon — if you are under 55!

Provident Mutual

Life Insurance Company of Philadelphia, Penna.

Founded 1865

Mail this Coupon NOW!

PROVIDENT MUTUAL LIFE INSURANCE CO.
Philadelphia, Pennsylvania

Please send free descriptive booklet and quote premium rate for the Provident Providor at my age, with the understanding that it places me under no obligation.

I was born _____
Month Day Year

My name is _____

Home address _____
Street City State

Business address _____
Street City State 12PSM

Copyrighted material

TO STOP LEAKS IN HEATING SYSTEMS

LEAKS in steam or hot-water boilers, radiators and pipes, in hot air furnaces and ducts, at cracks in ovens and smoke pipes are so easily repaired with Smooth-On No. 1 that you can do as good a job as a professional fixer, and keep practically the whole repair expense in your own pocket.

Boiler Crack

Radiator Leaks

Cracked Fire Pot

Cracked Ovens

Stove Pipe Leak

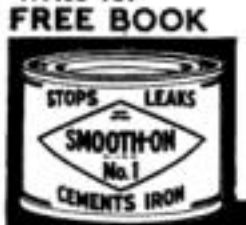
Smooth-On No. 1 metallizes in hardening, holds in iron, steel, brass or copper and makes a perfect seal against leakage of steam, hot or cold water, hot fumes, gas, gasoline or oil. Engineers in big power plants have used it for 30 years in mending cracks and breaks and in stopping leaks at threaded, flanged and pressed joints.

As an anchoring material, Smooth-On No. 1 also affords a quick, easy, cheap and dependable means of tightening loose handles, resetting stripped screws in metal, masonry or wood, fastening loose casters, loose metal post ends in concrete, etc. Use it on your car to mend a leaky radiator, cracked water jackets, leaky hose, exhaust or heater connections, to fasten loose hub caps, lubricator inlets, loose nuts and stripped wood screws.

Home, car and shop owners find profitable uses for Smooth-On No. 1 every month in the year, and save from 50 cts. to many dollars on every application. By keeping a can of Smooth-On No. 1 in your repair kit and following the simple directions in the Smooth-On Instruction Book, you can make many emergency and routine repairs the instant trouble shows up and almost without cost.

Get Smooth-On No. 1 in 7 oz., 1-lb. or 5-lb. tins at nearest hardware store or if necessary direct from us.

Write for FREE BOOK



FREE

This booklet tells how to make home repairs, also how to stop water leaks in automobile radiators, cracked water jackets and at loose hose connections, also how to stop gas leaks from the tank, gasoline lines and exhaust system, and oil leaks at gaskets and at cracks in crank or gear case. It also tells how to make headlight posts, nuts, hub caps and bolts and grease cups stay tight, and shows dozens of simple money saving Smooth-On repair jobs. Sent free if you return the coupon.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO. Dept. 58
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name.....

Address.....

1-32.....

HOW TO READ AN EARNINGS STATEMENT

(Continued from page 5)

times as much as the amount needed for fixed charges. So bondholders need not worry; their interest is safe. Now take the preferred stock. For the 2,000—7% share issued, a net income of $178,092 is left—or $89.04 a share, which is also fully ample.

"If there is any cause for alarm, it lies in the common stock which is hardly as attractive as it was in 1929 when they earned $12.58 a share and paid an $8 dividend. My advice to holders of common stock like this would be to watch most carefully the coming earnings statements of this company. If the downward trend continued, it might become serious enough to warrant investigating the underlying causes of this decline in net results, for they might finally undermine the investment value of the stock. On the other hand, if the 1931 statement should show that the 1930 decline was the result of temporary factors only, the stock would still deserve an excellent rating." Walter paused to light a cigarette, and then continued, "Now, Fred, you know as much as I do about earnings statements and the value of analyzing them for investment purposes."

"And that's a good deal more than I knew before I came in here," answered Hobart.

"You have given me a lot of good pointers that I hope I won't forget when the time comes to remember them. But right now we're both forgetting something."

"What's that?"

"That we have homes!—and that we're late as it is. I'm leaving now—see you tomorrow."

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

OFFICES IN 51 CITIES

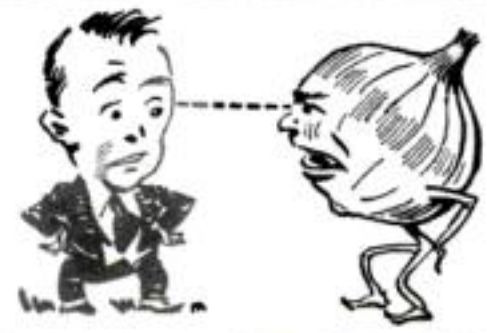
Their Future

ASSURE college advantages for YOUR child—easily—surely—by setting aside as little as $13.00 a month. Return this advertisement with your address for pamphlet fully explaining the Investors Syndicate Plan, used by

200,000 INVESTORS

INVESTORS SYNDICATE

FOUNDED·1894
MINNEAPOLIS
BOSTON-LOS ANGELES
MONTREAL



ONIONS?

I Like 'Em But They Don't Like Me

WHEN onions or any other food disagrees, you can quickly relieve that "gassy" feeling by eating a few Tums—the new delicious Antacid mints that you eat like candy. Tums quickly neutralize excess acids—ending heartburn, acid indigestion, sour stomach, and purifying the breath. So much handier and agreeable to use—just carry a roll in pocket or purse and eat a few after every meal. At all druggists'—try them today. Only 10c.

TUMS ARE ANTACID—Not a Laxative
For a laxative, use the safe, dependable Vegetable Laxative NR (Nature's Remedy). Only 25c NR

A definite program for getting ahead financially will be found on page four of this issue

"How Do I Know It's Christmas?"

(By A Man Who's Been Through It Many Times)

"EVEN without holly and tinsel, trees and ornaments, I'd know it. One day—every year without fail—I walk into a room where there are a lot of packages marked for me. After they are opened, I find myself richer to the tune of one dozen neckties and two dozen pairs of socks. 'This must be Christmas', I say—and so it is.

"Now, I know that every Christmas present comes from the heart, but I'm practical and I wish they'd put a little more 'head' in with the heart. Neckties come in such astounding colors that I'd rather pick my own. And you can't do much with Christmas socks that are a size too large or a bit too small.

"Just let me put in a word for myself—and for a couple of million other men like me. We like Christmas presents, and we like to give them. But when we're on the receiving end of the exchange, it does our hearts good to get a really sensible gift—of practical and permanent value. Something that gives us enjoyment, something that reminds us of the giver—makes us think of him gratefully—six months—twelve months after Christmas has come and gone."

• • •

That's a frank, man's point of view. Isn't it yours? Aren't there men you know who you're dead certain feel that way? Wouldn't such a man say you used both *heart* and *head* when you sent him Popular Science Monthly for a year, as a Christmas Gift?

You know—without our telling you—what a delight Popular Science Monthly, with its fascinating news and amazing photographs of scientific progress all over the world—can be to the man who wants and values a practical gift. When you make this gift—be he father, son, brother or friend—a year's subscription to this graphic magazine, every new issue brings him another reminder of Christmas—and another grateful thought for the friend who made so wise a selection.

While we're on the subject of gifts, we'd like to give a little Christmas present ourselves. The regular subscription price of Popular Science Monthly is $2.50 a year—but, to every reader who wishes to send the magazine as a gift, we'll give our own Christmas present of fifty cents, so that, for each friend to whom you send Popular Science Monthly on this special occasion, you need send only $2.00 instead of $2.50. Here, however, is a gift you cannot measure by cost, because it is so very inexpensive—and yet its worth in terms of interest and genuine pleasure for the gift receiver is invaluable. And, to carry out the spirit of the season still further, we shall mail to every friend to whom you send Popular Science Monthly as a Christmas Gift, an appropriate Christmas Card, bearing your own name and your good wishes, and telling him Popular Science is coming as your gift.

If you want to send a gift that means something—and, if you want to avoid the discomforts of last-minute shopping in crowded stores—Popular Science Monthly is certainly the solution to this year's gift problems—for every man on your Christmas list. Use the convenient order blank, sending your remittance now or indicating below that you wish to be billed for the amount after the Christmas Holidays—and mail it back to us today.

POPULAR SCIENCE MONTHLY
381 Fourth Avenue New York, N. Y.

Send Popular Science Monthly for one year on your special Christmas offer of $2.00 for a year's subscription to the names written below—and also send a Christmas Card bearing my name and greetings for each separate gift subscription.

I am enclosing $..... to cover these subscriptions.

Bill me $..... after the Christmas Holidays.
(If you wish to pay later, indicate it above)

Put Your Own Name and Address Here
(We may need it for correspondence, billing, etc.)

Name.....

Address.....

City.....

Write below the names and addresses to which you wish to send the Magazine

Name.....	Name.....	Name.....
Address.....	Address.....	Address.....
City.....	City.....	City.....

Copyrighted material

INDEX
Guaranteed Advertisements

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Copyrighted material

Let us send your copy of this new LATHE BOOK...

which shows even the beginner how to do hundreds of different Lathe *jobs!*

Here's the newest, most up-to-date book on the operation and maintenance of geared head engine lathes. Every machinist will want a copy. It contains a mass of new and valuable information, told so simply and with such clear diagrams that even a beginner will find it easy to get the most out of a good lathe. Just follow the instructions in this brand new 76-page lathe book. Send coupon today for your copy.

TELLS ALL ABOUT LATHE WORK

—Grinding, Centering, Attachments, Methods of Holding Work, Cutting Speeds, etc.

"Encyclopedia of Lathe Operation" would be a good name for this new book—it's so complete. Ten big chapters, from the setting up of a lathe to a series of valuable machinists' tables, fill its profusely illustrated pages. The instructions on leveling a lathe, checking the motor and proper lubrication, will give the machinist many new hints, and show the beginner how to make the proper start.

There is a big chapter dealing with lathe tools, their purposes and how to use them correctly. Then follows proper grinding of lathe tools. Centering work, and method of making tests. Information on cutting speeds, and the correct speeds for running on different materials. "Chatter" is thoroughly discussed, telling its cause and how to get rid of it.

Install one and watch it *pay for itself before you have to pay for it* on our Easy Payment Plan!

Our easy payment plan makes it possible for you to own a Regal Lathe for less than $30.00 a month. And every month the Regal, with its capacity for doing work formerly expected of higher-priced lathes only, will bring you more than enough in added profits to meet these payments. Get a Regal—and watch it pay for itself.

Regals are built for home craftsmen, garages, repair shops and light manufacturing. They are subjected to LeBlond precision tests before leaving our factory. These modern engine lathes are equipped with 8-speed selective geared headstocks that make speed and feed changing sure and simple. Feed rod takes wear and tear off the lead-screw. Deep, rigid bed of close grained nickel steel alloy iron. All moving parts enclosed. No overhanging obstructions. Built-in motor with V belt drive. Lathe furnished with all necessary equipment, ready to operate. Made in five sizes, 10" to 18". Prices range from $275.00 to $947.00, F.O.B. factory.

Catalog Free

Along with your copy of the Lathe Book let us send you our new 1932 catalog FREE. It contains descriptions, pictures and diagrams of 1932 Regal Lathes—operation charts, oiling diagrams, shop hints, and prices on Regal Lathes, units and accessories. Get your copy and see for yourself how much a Regal Lathe offers.

MAIL THIS COUPON FOR YOUR COPY

THE R. K. LE BLOND MACHINE TOOL CO.
CINCINNATI OHIO, U.S.A.

The R. K. LeBlond Machine Tool Co.,
209 Regal Division, Cincinnati, Ohio.

Send me a copy of your newest catalog FREE. And here's 25c to pay the cost of sending the big, new 76-page Manual of Lathe Operation — Running a Regal.

Name .....

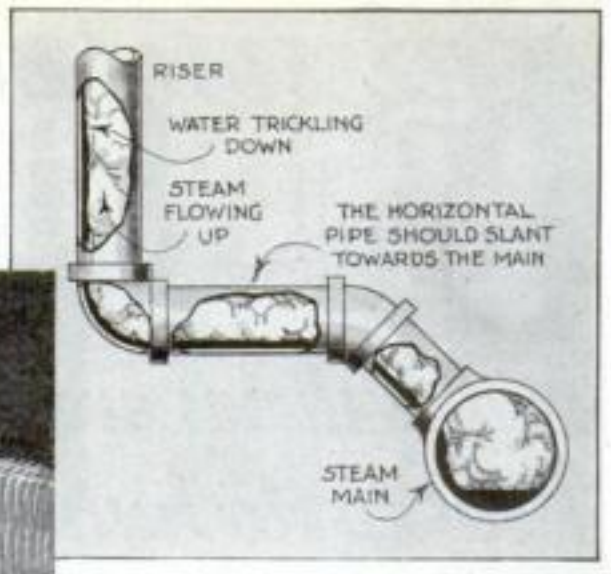
Address .....

City ..... State .....

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 8

Copyrighted material

Like automobile radiators, the variety shown below cram much radiating surface into a small space and heat readily. Right, how both steam and water flow in same pipe



Maximum Heat from Your Radiators

By COLLINS P. BLISS

Dean, College of Engineering, N. Y. University
Director, Popular Science Institute

HEATING engineers have been doing much work recently on the subject of radiators; as a result a number of radiator developments have been made and research now under way is expected to do much to improve this part of the heating system.

The conventional cast-iron radiator is simply a device to cram a considerable length of steam-filled tubing into a small space. The sections are hollow, and steam, entering at one end, fills the network of pipes or hollow tubes of which the radiator is made. The outside of the radiator is so shaped as to expose to the air as much metal surface as possible.

The heat of the steam is transmitted to the room through the radiator in several ways, about thirty percent being emitted as radiant heat to the walls, furniture and other objects in the room. This kind of heat could be felt even if the radiator were inclosed in a glass box. The rest of the heat, the larger part of it, is imparted directly to the air near the radiator. Theoretically, this air should circulate through the room by rising to the ceiling, traveling across the room, cooling somewhat, dropping to floor level at the opposite wall and returning across the floor to the radiator to complete the circuit.

This, however, is rarely accomplished, and, obviously, is not an ideal way to heat a room. The upper half of the room, above the breathing level, gets the most heat. Some of this heat is not wasted, because it warms the floor above, but the place in the living zone, where heat is most desired, gets the least.

One of the aims of heating engineers in working on the problem has been, therefore, to get the heat where it is wanted. Some ways have been found to improve this situation, although they have not yet become standardized. Knee-high instead of waist-high radiators are a step in the right direction, tests show. But engineers have gone further. Several ways have been found to heat the useful part of a room.

ONE new kind of radiator heats by "radiant heat" alone, being designed so that no air passes around it. The metal *radiates* heat, *sideways,* directly into the room. This is done by presenting a solid smooth metal surface to the room instead of the usual columns. Another new kind of radiator emits practically no radiant heat at all, but is a highly efficient air heater. The special cabinet in which it is inclosed directs the air straight out from the radiator into the room, instead of allowing it to soar at once to the ceiling.

There are many radiators on the market today using some sort of cabinet or inclosure, each far more efficient for heating the lower part of the room as described before and for concealing the radiator on artistic grounds. Those that are completely recessed in the wall are known as concealed radiators; exposed radiators are covered with radiator cabinets. Some of the latter use conventional cast-iron radiators, others new lightweight types.

In both concealed radiators and radiator inclosures may be found types giving the efficient heating effect desired. Each type, also, may be badly installed or designed. A good installation gives heat up to the full capacity of the radiator, sometimes even improving its heating effect, because the well designed air passages act like a chimney and give a draft. In a bad installation this effect is absent, since a front inclosure is lacking, and also there are surfaces that obstruct the passage of air. Such an inclosure will lower the heating value of any radiator.

Whether a radiator is painted with metallic or nonmetallic paint makes a difference of nearly seventeen percent in the effectiveness of the radiating surface. For example, a five-section radiator painted white or black, or even with colored paint, would be as good as a six-section radiator painted with bronze or aluminum paint. The difference is due to the radiant energy of the surface itself rather than to any insulating effect of metallic paints. Therefore the number of coats of paint have no effect on the results, unless it gets so thick as to act as an insulating covering. It is the last coat put on that does the trick.

AS TO materials for radiators, it has been found that satisfactory radiating surfaces can be made of other metals than cast iron—copper, brass, or aluminum, for instance. The heating element, a pipe of this material with extended fins of sheet metal, occupies a surprisingly small space and therefore can be hidden in cabinets and walls. The type shown in the illustration is only three and a half inches thick.

The new types of radiators developed for steam systems described above are equally applicable to hot water systems. A radiator used for hot water merely utilizes an extra pipe connection for the return branch. Special valves adapt such radiators for vapor systems.

Copyrighted material

BECAUSE OF THIS SPIRIT

THE biggest thing about your telephone is the spirit of the hundreds of thousands of people who make up the Bell System. No matter what their particular jobs may be, they are first of all telephone men and women.

The loyalty of these people to the ideals of their work is reflected in every phase of your telephone service. It shows in the increasing speed with which your local and long distance calls are completed. It shows in the greater accuracy with which they are handled. It shows in the wider and more convenient facilities which are placed at your command—extension telephones, intercommunicating systems for home and office, small and large switchboards, teletypewriters and many others.

Because of this spirit, your needs for fast, complete and inexpensive telephone service are more fully met each year. Men and women of the Bell System are constantly explaining the varied telephone services to more and more users. They prepare the way for the new plant and equipment put at your disposal every year. Through their efforts, you receive better and wider service at a cost made possible only by an organization of this character.

Although it does not appear on the balance sheet, the greatest asset of the Bell System lies in the skill, energy and purpose of the people who carry on its work. Every time you telephone, you get the advantage of this—in better and better service at the lowest possible cost.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

Copyrighted material

Our Readers Say

The Facts Are Ancient and This Problem May Prove Difficult

WILL some reader help me solve a problem that has bothered me for some time? I am not mathematician enough to figure out what loading capacity Noah's Ark had, nor can I estimate or imagine the total weight of a "pair of each and every living thing that creepeth upon this earth." There were some creepers in those days, don't forget. Beside some of them our elephants would look like pygmies. Perhaps some one of Dr. Gregory's ridiculers will be so kind as to furnish me with the statistics and show me how it was possible for Noah to take such a cargo on such a craft.—L.A.N., Paradise, Cal.

Wail of the Critics Just Burns Him Up

I AM a regular reader of POPULAR SCIENCE MONTHLY and am well satisfied with the variety of articles and the clear way in which they are presented, but it burns me up to read about fellows who think that "tall buildings slow up the earth's rotation" and others who are "not interested in the beginning and development of man." Someone also asked for more science and photography and less flying. If flying doesn't involve science as much as photography, I'll go into exile. I advise those who think there isn't any science in this magazine to take a good look at the cover of any issue.—C.S.B., Teaneck, N. J.

Popularity Helps Us to Escape the Pruning Knife

I HAD made up my mind not to resubscribe for your magazine, not because I did not like it, but as a measure of economy. However, my family prefers POPULAR SCIENCE MONTHLY to some other magazines we are receiving so I have decided the pruning knife will go in a different direction.—J.H.B., Quincy, Ill.

Little Boys Wear Ribbons, Too

ILLUSTRATING the effects of giving thyroxine, page forty-two, December, you print before and after pictures, the first showing a beribboned little girl, the second a little boy. Science certainly is wonderful!—M.K., New York, N. Y.

Can Anyone Straighten Out This Crazy Compass?

I AM sending you a problem that has cheated me out of many hours of sleep. Suppose a ship is halfway between the equator and South Pole. What would happen to the compass? If it tried to point to the North Pole, would it not take the shortest route? If that is true, why wouldn't the compass point through the ground to the pole? Your readers have answered everything else in the world so maybe they can guess the answer to this one.—R.L.H., Galveston, Tex.

He Wants Book Reviews in Your Pet Magazine

THERE is one thing lacking in POPULAR SCIENCE MONTHLY that would be liked by many. That is a review of the science books of the month. I do not believe that your paper has this in it. If I am mistaken will you please tell me where to find it in the magazine.—R.R.B., New York, N. Y.

How About "Auto Kinks" and Good Old Gus and Joe?

I AGREE with C.M. of Lakewood, Ohio. You certainly ought to have more articles on automobiles and perhaps a department devoted to gadgets that add speed, power, and performance to cars in general and small cars in particular. To advance a reason for assuming that this move would be popular, I need only remind you of the number of car drivers who read your magazine regularly. What driver wouldn't be interested in adding some pep to the family "chariot" or to his own dilapidated Model T?—W.B.M., Jr., Chatterton, Va.

He Saw Indian Use Cubé Poison to Catch Fish

IN YOUR article, "New Indian Poison Aids War on Bugs," you say it was to South America they went to get cubé root. Now it was not necessary to go so far to get the poison. In the district in Mexico in which I lived for a number of years, the Mexicans had a fish fry on the first day of April each year. A week or so before that date a dozen of the Indians would go to the mountains and dig cubé roots. At the fish catching, thirty or forty of them would line up on the bank near shallow water. Each man had four or five pounds of the root in a burlap sack and when this was pounded against the rocks the juice gave the water a milky color and soon the fish would come to the surface and flounder around gasping for air. As they floated helplessly downstream the Indians would grab them. In this way fish were caught for the big feast. The fish did not seem to be poisoned, and in a few minutes completely recovered from the effect of the drug. Their flesh was not in any way affected by the drug.—E.B.R., East Lake, Fla.

Should Keely and His Motor Be Forgotten?

WHY do not some of you informers of the public tell the younger generation something about the Keely Motor of the gay nineties, which was all right "only it wouldn't mote?" Just as we laughed poor Langley into his grave and have lived to see his ideas survive, so we are now tracking in the steps of Keely and our college profs are teaching his theories and Keely is wholly forgotten. Why be ungenerous and deprive Keely of what is his even if he did resort to fraud to get money to develop his motor? After all it is evident he was a mechanical genius and is entitled to consideration.—F.W.D., Creston, Ia.

Here's an Old, Old Gun with Its History Unsung

I SHOULD like to know if you can help me out on a problem I have been trying to solve. I own an old muzzle-loading rifle weighing nine and three quarter pounds. It was made by Hitchcock and Muzzy. There is no date on it. The barrel is octagon in shape and thirty-four inches long. The firing pin and hammer are placed on the underside of the barrel. The butt is of light brown hardwood and on the left side is a pocket for percussion caps. The only marks are under the brass trigger guard and on the end of the barrel at the butt where the name "Dover," the initials B.S., and the figures 105 appear. Can you tell me anything about it, such as the date and place of manufacture? Or can any of your readers give me this information, which I am anxious to get?—H.R., Lowell, Mass.

Discoverer of Cannibal Germs Praises Our Article

CLAYTON R. SLAWTER wrote a most interesting article on the "New Found Cannibal Germs" in a recent issue of P.S.M., much the most comprehensive of any that have come out recently in the public press, and I have enjoyed reading it very much. Not the least important part of this article is the relationships which are brought out between one and another field in bacteriology. Too often semi-popular articles are very misleading in that they do not give any background for the reading public to build upon.—Arthur I. Kendall, Chicago, Ill.

Gregory Is The Bunk, but the Rest of the Book, Oh, Boy!

I HAVE been a reader of your magazine for several years. It is one of the best I have ever read. Professor Gregory's stories are the bunk, but those of the Crime Detection Bureau are fine. Give us some more picture puzzles like those on page forty of the September, 1931, issue. Your Home Workshop Department is one of the best I have ever seen. Although I am not making one, George Waltz's haps and mishaps in the construction of his television receiver make good reading. I am glad to see that you let only first-class advertising in your magazine. Whenever I see an article that I have seen advertised in POPULAR

Copyrighted material

SCIENCE MONTHLY I do not hesitate to buy it, because I know it would not be advertised in your fine magazine unless it was first-class. —H.W.R., Charleston, S. C.

Predicts Rough Trip for Motorcycle Soldiers

IN READING your October issue, I was interested in the article on the new motorcycle troop developed by the Army to replace the cavalry unit. Among all the recent military developments, this one certainly seems ridiculous. Any schoolboy knows that a battle ground is not like a paved street. Imagine this motorcycle troop trying to drive through trees, brush, over rocks, stones, ditches, shell holes, fences, rises, and gullies, and at the same time firing accurately and effectively at an enemy. In the first place the drivers would be struggling with the machines, and under such conditions would certainly not prove practical as a successful warfare unit. The Government, in my opinion, would be much better off if it spent more time and money in aeronautical advancement, instead of amusement devices for the land troops. Every one knows the next war will be fought in the air, and not with motorcycles.—L.S., Tulsa, Okla.

Condensed and Complete— That Describes Us

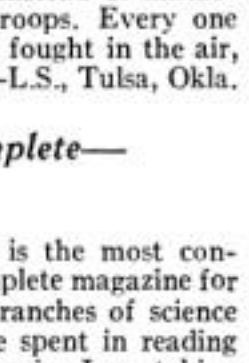
I THINK your magazine is the most condensed and yet the most complete magazine for keeping up to date on all branches of science in the least amount of time spent in reading it. Hence, it is the only magazine I am taking to college with me. An engineering student working his way is and must be very considerate of time. Keep up the good work, and above all boost Aviation.—R.R.M., Stillwater, Okla.

You Scientist Chaps Are Hurting the Constitution

I READ with interest the letter by G.B.B. of Dutch West India concerning the scientists (?) spending so much time trying to prove the Bible a lie. I say a hearty "amen" to every word in that letter, and wish to add that those so-called scientists who pretend to be able to correct God's mistakes are doing more to undermine the Constitution of the United States than any other class or group of people, domestic or foreign, communists not excepted. To the same degree that they succeed in persuading people to discredit the Bible, to that degree they destroy the people's respect for the Constitution, which is founded on the principles taught in the Bible.—H.A.E., Lone Tree, N. D.

Chemical Experiments Coming Soon—Watch for Them!

FOR Pete's sake print some good chemistry articles and experiments! I have seen many such requests in "Our Readers Say," but I have never seen one experiment in your magazine. You certainly would please a lot of people if you ran some. I know of two people—I'm one of them—who want chemical experiments. Don't you think that out of 120 million people in the United States there are many more? Come on, give it a trial.—H.C.M., Jr., Sandusky, O.



Those Russian Articles Are Still Bobbing Up

I AM a recent recruit among the admirers of POPULAR SCIENCE MONTHLY, and all I can say is keep up the good work of spreading scientific knowledge throughout the world. By the way, I think it about time someone stood up in defense of F.P.S., of Denver, Colo. POPULAR SCIENCE MONTHLY, as I understand it, is a scientific magazine and not a political propagandist. So, then, why publish articles on Russia's five-year-plan, which after all is nothing but a screen to hide the suffering of an oppressed people? In answer to the letter of M.S., of Nicolaieff, Russia, in the October issue, may I add that perhaps the reason why he exalts the Soviet government is because he himself may be paid for spreading Soviet propaganda. Russia may have no aristocracy but it surely has a despot in the person of Stalin.—E.M.B., Baranoff, Wash.

That Arizona Meteor Exploded When It Struck

IN A recent issue of POPULAR SCIENCE MONTHLY, E.B.M. wishes to know where L. St. J. H. of Richmond, Calif., gets his information about meteors. He claims that he has photos of them falling at certain degrees from the perpendicular, etc. He has not photographed meteors for the simple reason that if he photographed them they necessarily were incandescent and they were probably fifty miles above the earth. Now what E.B.M. does not seem to know is that meteors fall at a terrific speed through space, where there is no resistance to speed and no friction. They may come at any angle before they strike the atmosphere, but as soon as they strike the atmosphere the friction heats them and nearly all of them burn before they reach the earth. Those that do manage to reach the earth are checked by the atmosphere, cool off, and are not seen, but they strike the earth perpendicular to the surface. At the Arizona crater, there is no evidence by the shape that the meteor struck at an angle, no way to tell how it struck. They assumed that it struck at an angle, so they bored at one side and spent a barrel of money and found nothing. Then they were going to bore in the middle of the crater, but concluded that it was not one solid unit but made up of many small units. When it struck it must have exploded and scattered all over the neighborhood, so the mining operations are abandoned. —L. St. J. H., Richmond, Calif.

Here's a New Word to Take Place of Evolution

MUCH as we find ourselves burdened with scientific terms, there is yet much confusion from the loose way in which the term "evolution" is used. By many textbook writers it signifies the changes that have occurred in the past, resulting in the present population of plants, animals, and human beings; while other writers involve speculative ideas as to the causes of these changes and elaborate at length as to the various theoretical aspects of the problem, until the average student is confused as to what is true and what is merely speculative. A term is needed that will separate the body of facts from the interpretations that have been given to these facts. At present the word *evolution* implies both a philosophy and a mass of scientific facts. These two ideas should be separated. For a term to cover the ideas just expressed, I have been using the word *Biotropy*. Defined, it would be as follows:

Biotropy: the changes that have occurred in living organisms under the influence of environment; the body of facts dealing with the changes in living things. By using the term *biotropy* we can make the great mass of scientific facts acceptable to all schools of thought, irrespective of their opinions as to the forces involved.—H.W.C., Angwin, Calif.

Descriptive Articles on Motors Are Politely Requested

I HAVE read many issues of POPULAR SCIENCE MONTHLY and have always found articles that were interesting and informative. Some articles were not read because they did not contain anything of interest to me. However, that did not prompt me to write you that inasmuch as I did not like this, that or the other article, you should stop publishing that sort of thing. To do that is silly, because you cannot please everybody. It is, of course, almost impossible to sell your critics an idea of that kind. I invariably derive a great deal more than twenty-five cents worth of satisfaction from each issue that I buy. Perhaps you may have both the inclination and the space to publish an article on electric motors, telling about the different types of A.C. and D.C., and what use each is best suited for and why. An article of this nature should be of widespread interest, because although electric motors are in use all around us, few know little or anything about them. As the use of the Diesel engine is increasing fairly fast, a similar descriptive article on it should be of interest to many of your readers. However, if you do not believe it advisable to comply with my request, I will not stop reading POPULAR SCIENCE MONTHLY, and I will not write you that you are publishing an extremely poor magazine.—H.M.M., St. Louis, Mo.

Thinks Science Lags Far Behind the Real Inventors

IN THE Dark Ages, religion dominated the public mind. Now it is science that tells us what to think and do. The unrestrained glorifiers of science put it in place of God and ascribe to it all good things, just as religion once claimed that everything happened for some purpose of God's. These scientists are unwilling to admit that their creed expresses only half truths and is the result merely of conscious selection and rejection of phenomena. Science lays claim to all inventions, even though the inventors were ignorant of science, a condition that has not infrequently obtained. The truth is that inventive ingenuity is far ahead of scientific theory. Why do you always boost these worshippers of science? Why not give a chance to those who dare to tell of the failures of science?—A.E.P., Santa Rosa, Calif.

Pinhole in Cigarette Will Give You a Cool Smoke

READERS may be interested to learn of this little experiment which was described to me a few days ago by a continental friend of mine. He expressed his surprise that the trick is not more universally employed in England and America. Before lighting your next cigarette pierce the paper with a pin about half an inch from the end which is not to be lighted—only a small prick through the paper is necessary—then proceed as usual. You will be surprised.—G.H.B., Cardiff, Eng.

Copyrighted material

PRESDWOOD . . .
REG. TRADEMARK
puts *speed* in industry

Masonite Presdwood, the all-wood grainless board, grew up with the machine age—with the crash of presses, the whir of planers, the bite of drills. It thrives on the rushing speed of modern production methods . . . saves precious minutes on every operation . . . never slows up the production line. Works equally well with hand tools. Never splits in nailing close to the edge.

Everywhere they're used, these modern industrial boards, rigidly graded at the mill, cut labor and material costs, eliminate waste and rejections. For making good products better, nothing compares to Presdwood—for steel-plate strength, durability, imperviousness to moisture, and easy workability. It comes in lengths up to 12 feet, or cut to your specifications. Smooth in finish; rich brown in color. Apply lacquer, enamel, paint, stain, varnish—any finish you please.

A sample of Presdwood sufficiently large for testing will be sent on request. Also the Presdwood booklet telling the story of its manufacture and listing 80 of its uses.

Masonite
PRESDWOOD
REG. TRADE MARK
STRUCTURAL INSULATION · INSULATING LATH
QUARTRBOARD · Cushioned FLOORING
"Made in Mississippi"

"Made of Presdwood"—brooders, brooder coops and other poultry equipment made by the Klein Manufacturing Co., Burlington, Iowa

McDougall Company, Frankfort, Ind., manufacturers of kitchen cabinets, depend on Presdwood for the cabinet backs

The Grand Rapids Store Equipment Co., Grand Rapids, Mich., are enthusiastic over Presdwood. They use it for case backs

Ends of spools for silk thread, yarn and ribbon are made of Presdwood by the Apex Spool Co., Philadelphia

A pleasing moisture-resistant tile for bathrooms, lavatories, etc., is being manufactured from Presdwood by the Tylac Company of Monticello, Ill.

Incubators made of Presdwood by the Advance Manufacturing Co., Springfield, Mo., have won much favorable comment

Cut or processed *to your order*

The Masonite Corporation is now prepared to supply manufacturers with Presdwood specially processed to meet any particular requirement, or cut to any desired irregular outline or size. Check the coupon or write in for full information describing service required of board.

Send for Free Booklet

Mail the coupon today. It will bring you the interesting story of Presdwood

Masonite Corporation, Dept. D-21 © M. C., 1931
111 W. Washington Street, Chicago, Ill.

Please send your free illustrated booklet that describes Masonite Presdwood and its many uses.

Name.....

Street.....

City..... *State*.....

☐ If interested in specially cut Presdwood, check here

Copyrighted material

POPULAR SCIENCE
MONTHLY
January 1932 Vol. 120, No. 1
RAYMOND J. BROWN, *Editor*

He *Flew* an Airship Before the Wrights Were Born!

Drawing by B. G. SEIELSTAD

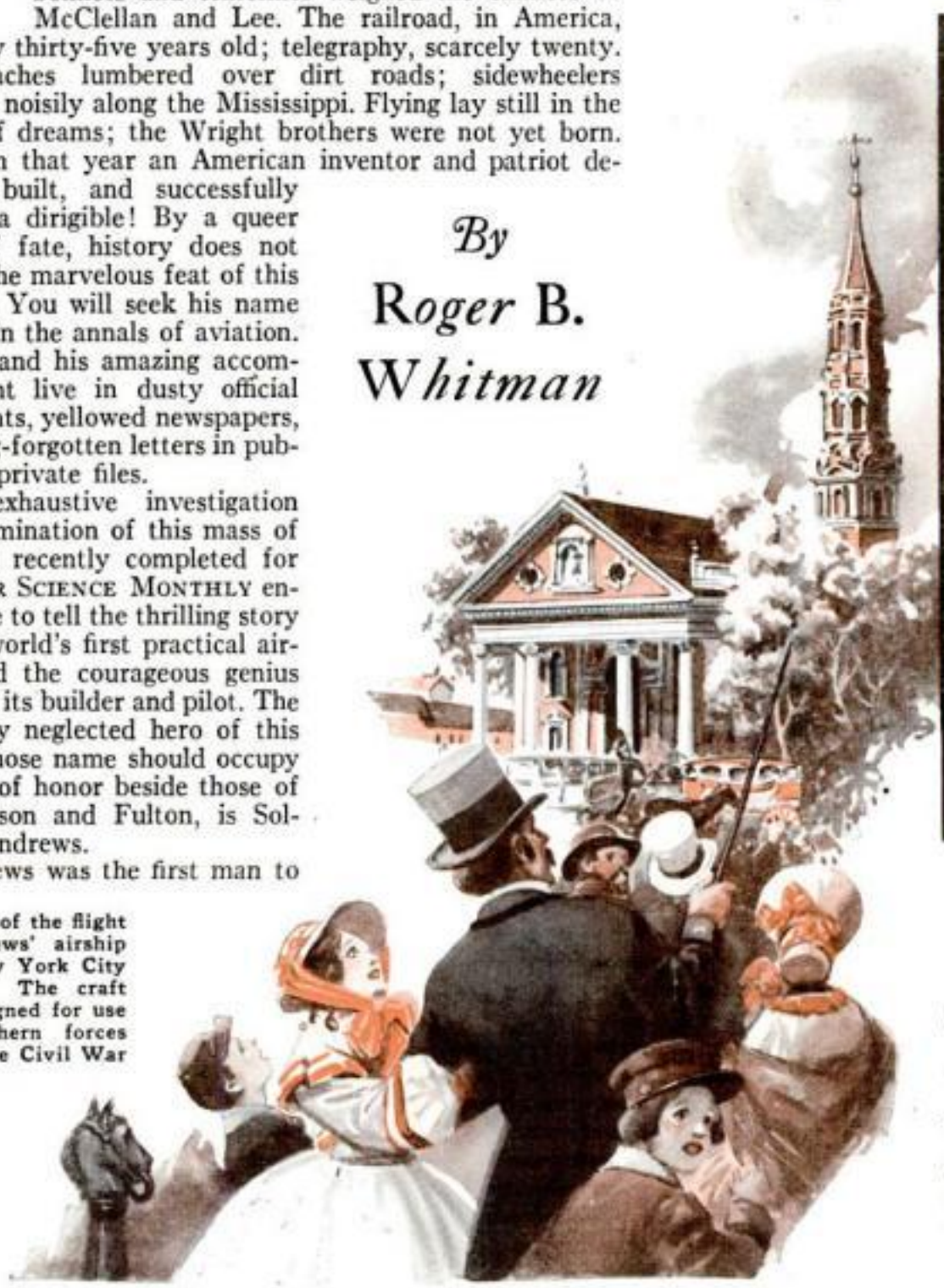
THE year was 1863; the month, June. The Civil War was at its height. Men in stovepipe hats and wearing sideburns and women in poke bonnets and crinolines weighed the chances of McClellan and Lee. The railroad, in America, was only thirty-five years old; telegraphy, scarcely twenty. Stagecoaches lumbered over dirt roads; sidewheelers churned noisily along the Mississippi. Flying lay still in the realm of dreams; the Wright brothers were not yet born.

Yet in that year an American inventor and patriot designed, built, and successfully piloted a dirigible! By a queer twist of fate, history does not record the marvelous feat of this pioneer. You will seek his name in vain in the annals of aviation. But he and his amazing accomplishment live in dusty official documents, yellowed newspapers, and long-forgotten letters in public and private files.

By Roger B. Whitman

An exhaustive investigation and examination of this mass of material recently completed for POPULAR SCIENCE MONTHLY enables me to tell the thrilling story of the world's first practical airship and the courageous genius who was its builder and pilot. The strangely neglected hero of this saga, whose name should occupy a place of honor beside those of Stephenson and Fulton, is Solomon Andrews.

Andrews was the first man to



Drawing of the flight of Andrews' airship over New York City in 1866. The craft was designed for use by Northern forces during the Civil War

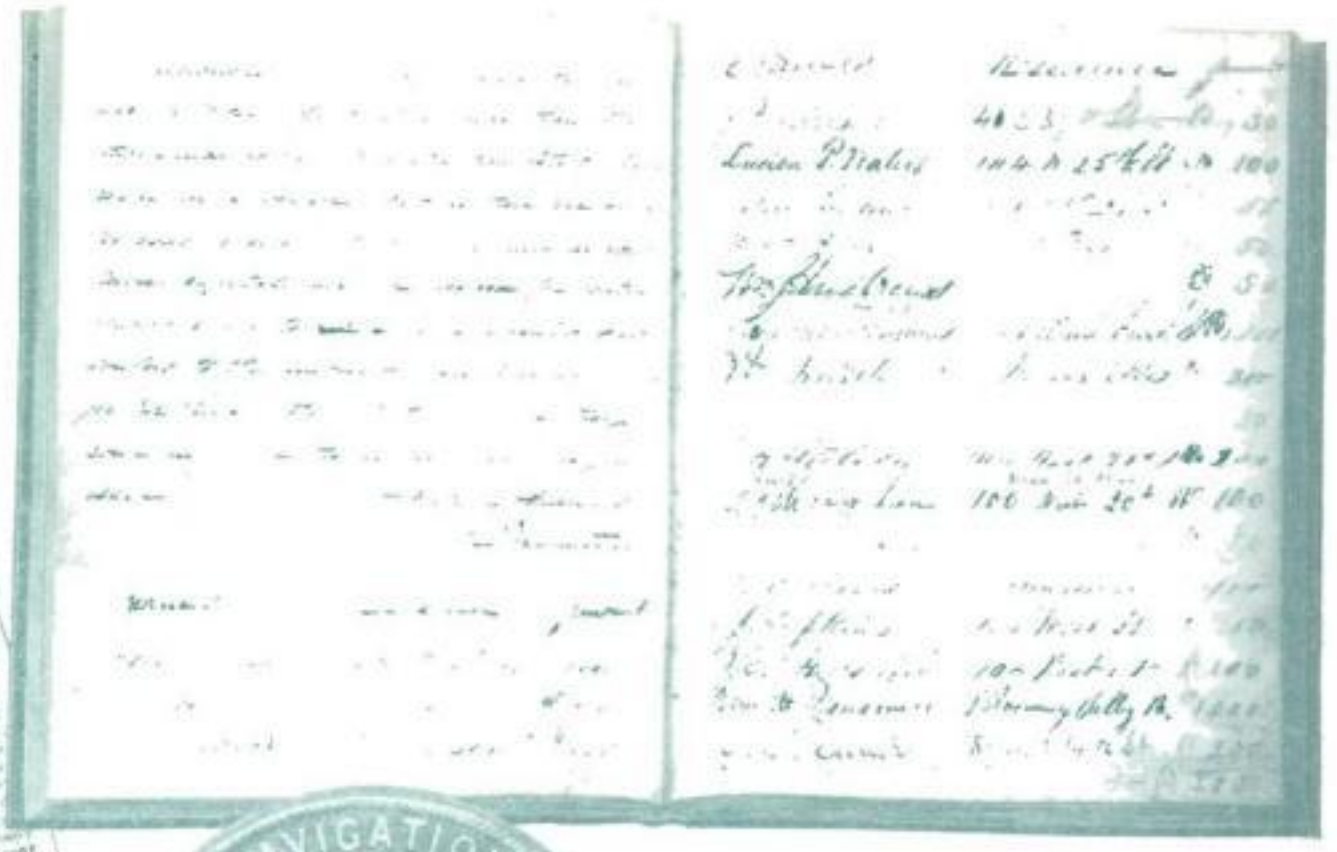
DR. SOLOMON ANDREWS

STARTLING FACTS Found in Old Records, and Set Forth for You in This Article, Prove Unknown American Built and Piloted a Dirigible More Than Sixty Years Ago

Copyrighted material

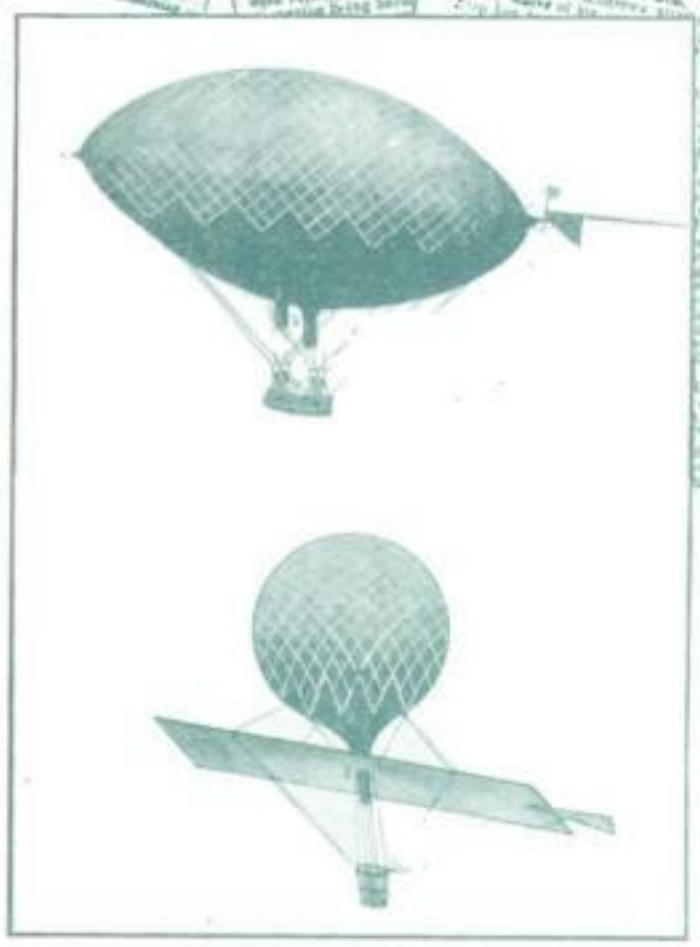
FIRST AIR TRANSPORT

At right, a reproduction of part of the original record book and list of subscribers to the first Aerial Navigation Company ever organized and formed to build and fly airships on a New York-Philadelphia route



Seal of the Aerial Navigation Company, charter of which was issued by New York in 1865

At left, clippings from papers of 1863 and 1866 which give graphic accounts of Andrews' successful flights over New York



Two drawings of airships made by Andrews and submitted by him to the Secretary of War. Neither of them was built. Note plane by which ship was to be directed up or down, and the steering by rudder

steer a course through the air in the United States, and he was the first man anywhere to do so with any degree of success. At a time when the only accepted means of rising from the earth was the free balloon, a prey to every wind that blew, he controlled his airship, a motorless gas bag propelled by an ingenious application of natural forces. He flew her independent of the wind, and steered her in any direction.

True, an earlier attempt at steering a balloon had been made, but the method used was so dangerous and impracticable as to reduce it to a hair-raising stunt. In 1852, the French engineer Henri Giffard had the hardihood to ascend in a gas-filled balloon driven by a steam engine. Of the man's reckless bravery there can be no question, but on the merits of his experiments expert opinion is sharply divided.

His fellow countrymen hand him the palm for flying the first dirigible. "With his balloon," says the French author Alphonse Berget in his *The Conquest of the Air*, "Giffard carried out some experiments of the greatest value. The low independent speed (three meters per second) which he obtained in conformity with his calculations did not permit him to describe a circle in the air, but he was able to make some very neat evolutions, deviating at his desire from the direction of the wind, thereby testifying to the efficiency of his rudder."

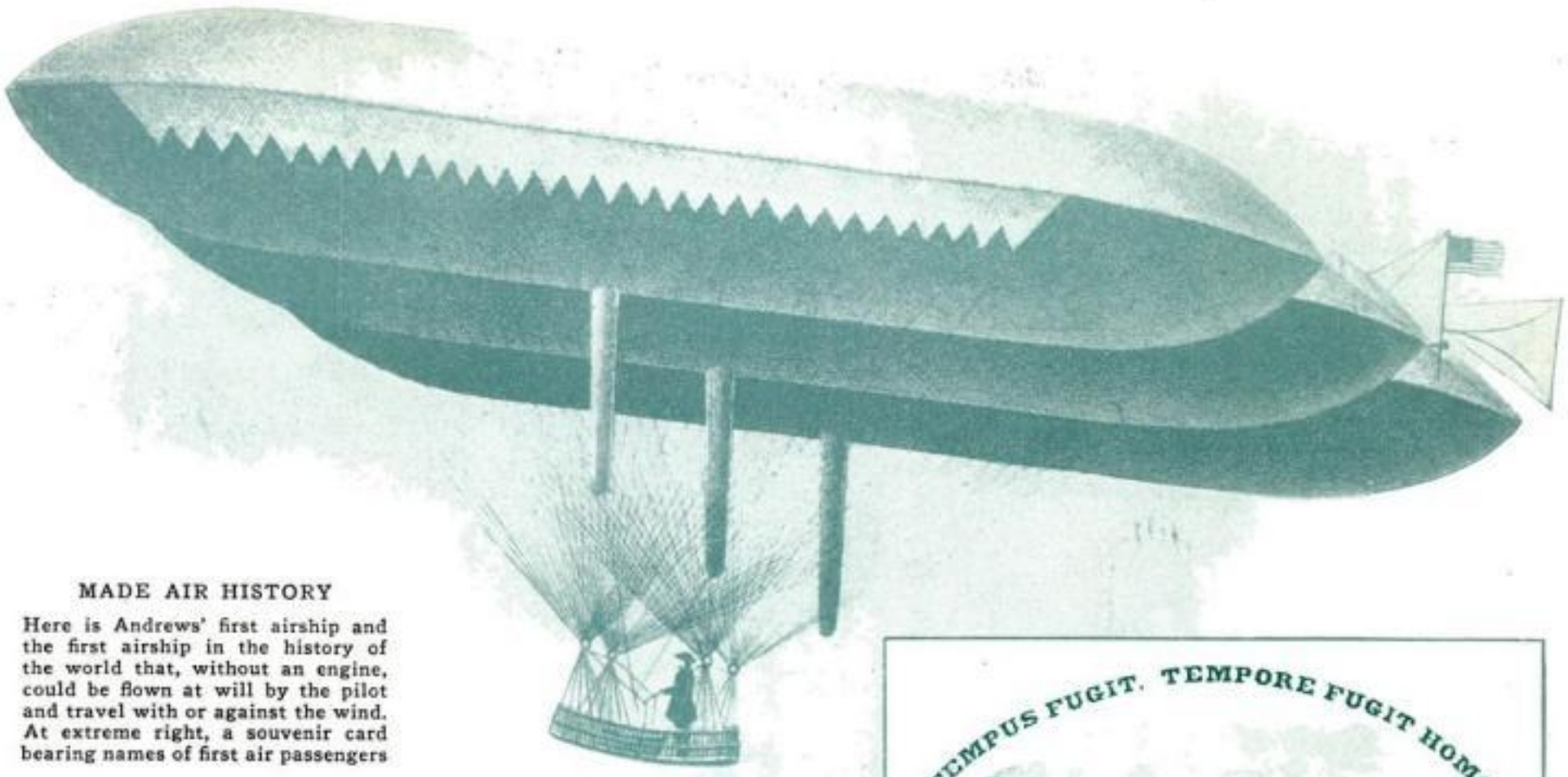
On the other hand, the Encyclopedia Britannica finds little of value in the experiments. "Giffard," says this authority, "devised a steam engine weighing, with fuel and water for one hour, 154 pounds per horsepower, and was bold enough to employ it in proximity to a balloon filled with coal gas. He was not able to stem a medium wind, but attained some deviation. He repeated the experiment in 1855 with a more elongated spindle, which proved unstable and dangerous."

No such diversity of opinion greeted Andrews' epoch-making demonstrations. Not a single dissonance of skepticism marred the chorus of praise that rose from the newspapers of the time. Nor did a word of doubt or criticism creep into the numerous statements and letters written by responsible private eyewitnesses. They were frankly amazed and thrilled by what they saw.

SO SHOULD you and I have been had we been there. Imagine yourself, for a moment, ignorant of the principles of aerodynamics. Wipe from your mind all knowledge of aircraft. Forget about airplanes, dirigibles, gliders, autogiros. Picture yourself living sixty-eight years ago, in a period when the free balloon was the only lighter-than-air vehicle. Then fancy your astonishment at seeing a man ride and control a gas bag!

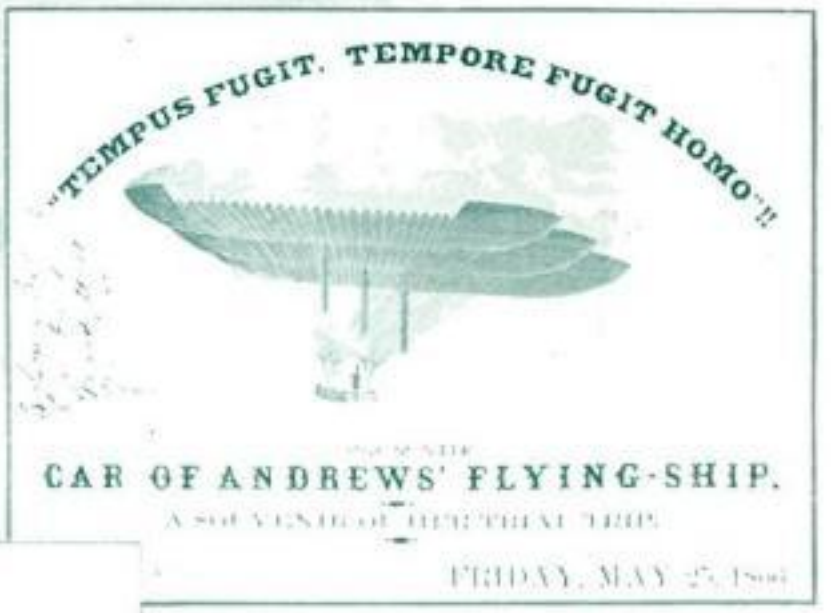
That is exactly what Andrews did. He navigated directly against the wind. He took three passengers into the air and landed them safely. He flew cross-country. He swung around in circles a mile and a half in circumference. He zigzagged back and forth over wide-eyed, cheering crowds that jammed the streets in the

Copyrighted material



MADE AIR HISTORY

Here is Andrews' first airship and the first airship in the history of the world that, without an engine, could be flown at will by the pilot and travel with or against the wind. At extreme right, a souvenir card bearing names of first air passengers



heart of New York City. Taking off from a certain point, he cruised about in all directions and succeeded in returning to his starting place.

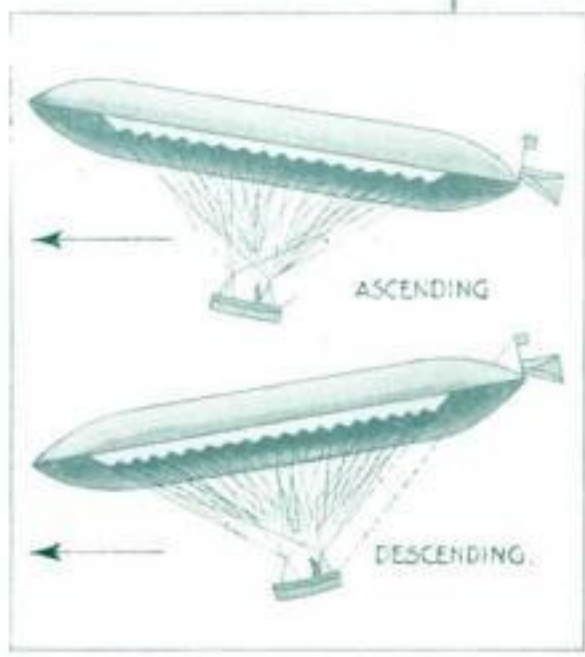
No wonder that the new, miraculous skyship was the sensation of the day. In New York, then about one tenth its present size, only the War rivaled Andrews' invention as a topic of excited conversation in parlors, coffee houses, market place, and street. "Navigation of the air is a fixed fact," exclaimed the New York *World*. "The problem of the centuries has been solved!" The New York *Herald* wrote: "We have this week the pleasure to record the success of the most extraordinary invention of the age, if not the most so of any the world ever saw."

ALMOST as remarkable, and historically quite as noteworthy as its performance, is the fact that Andrews' last airship, built just after the close of the Civil War, was constructed not by an individual, but by a company incorporated for the purpose. The Aerial Navigation Company, unquestionably the world's first organization for the commercial exploitation of aircraft, was chartered in November, 1865.

With money scarce and industry nearly paralyzed as a result of a financial depression, a group of hardheaded business men subscribed thousands of dollars to establish a regular air line between New York and Philadelphia. The company's charter, drawn up sixty-six years ago, authorized "the transportation of passengers, merchandise, and other matter from place to place." Can there be any doubt that this document, still on file in the offices of the County Clerk of New York County, belongs in a class with the charters of the first railroad and the first steamship company?

America's first air pilot was no crank or impractical dreamer. Living from 1806 to 1872, he was a prominent physician; a leading citizen of Perth Amboy, N. J., a much more important city than now; and an inventor with twenty-four patents.

Professor Joseph Henry, famous physicist and secretary of the Smithsonian Institution at the time, in an official report referred to him as "one of the most ingenious and successful inventors of this country." Dr. Andrews' patents ranged from barrel-making machinery to fumigators, from forging presses to velocipedes and gas lamps. His wickless oil burner, in which oil is converted into gas by the heat of its own flame, is used to this day. About 1834, when anthracite was first introduced for cooking, he devised the common kitchen range. But that which brought him nation-wide fame and substantial rewards was his invention of the first combination lock.



Above, how the ship was tilted to make it travel forward while going up or down

In spite of an extensive medical practice and ceaseless activity as an inventor, he found time to discharge a multitude of civic duties. For many years, he was president of the Board of Health, and distinguished himself by protecting his community against yellow fever and cholera. He served as Justice of the Peace, alderman, councilman, and thrice as Mayor. During the administration of President Tyler, he was Collector of the Port of Perth Amboy, at that time a rival of New York and center of the biggest oyster fisheries in the country.

A friend once said of Andrews that "he could not examine a mechanism without seeing an improvement that might be made in it." That such a mind should occupy itself with the problem of making a balloon obey its pilot was almost a foregone conclusion.

The notion that a balloon might be steered by natural forces occurred to Andrews when he was a young man. He studied the problem for years. By 1849, when he was forty-three years old, his solution had reached a stage where he found it necessary to protect it by filing a caveat with the Patent Office. This procedure, abolished in 1910, consisted in giving notice to the Patent Office to prevent the granting of a patent to another for the same invention during the life of the caveat without informing the first inventor.

His idea was simple enough, but of sufficient novelty and importance, even to this day, to be recognized as an aerodynamic principle used by modern airships. Had Andrews lived only twelve years longer, he would have seen his fellow American, John J. Montgomery, apply the same principle to the first glider (P. S.M., Oct. '30, p. 19).

Andrews proposed to apply to a balloon

Copyrighted material

the same principles that drive a sailboat. With a cross wind, the pressure on the sail is resisted by the pressure of water against the opposite side of the hull, and the boat moves ahead when the hull is held at an angle that will bring these forces together to give forward motion.

Similarly, the downward pull of gravitation on a gliding airplane is resisted by the air pressure under the wings. These forces combine to give forward motion as the plane is set at the gliding angle; and descent, instead of being in a straight drop, is on a long slant.

Until Dr. Andrews' time, most balloons were spherical, and met equal air resistance when moving in any direction. His idea was to shape the balloon so that there would be less resistance to forward motion than to motion up or down. To do this he made a balloon in the form of a fat cigar or, as he called it, a "flattened oblate spheroid."

From this bulging cylindrical envelope with pointed ends he suspended a basket containing a weight that could be moved from end to end. The shifting of this weight would tilt the entire machine and thus give the skipper control over the angle of flight. He calculated that an angle of from ten to fifteen degrees would result in satisfactory forward progress.

TO FLY, the bow would be tilted upward and ballast discharged to make the craft lighter than air. She would then rise; but with the lift opposed by the air pressure against the broad upper surface, her movement would be forward, at the angle established by the tilt. Once in motion, she could be steered with an ordinary rudder. Arrived at the desired height, the pilot would discharge gas to make the ship heavier than air, and with the angle reversed she would descend on a slant that would carry her farther ahead. In this manner, flight would continue until, through the discharge of gas and ballast, the ship would be brought to earth.

For his first ship, Dr. Andrews proposed to extend the gas bag over a frame eighty feet long, twenty feet wide, and ten feet deep. To house the craft, he put up a building 100 feet long, forty-six feet wide, and thirty-six feet high—the world's first hangar.

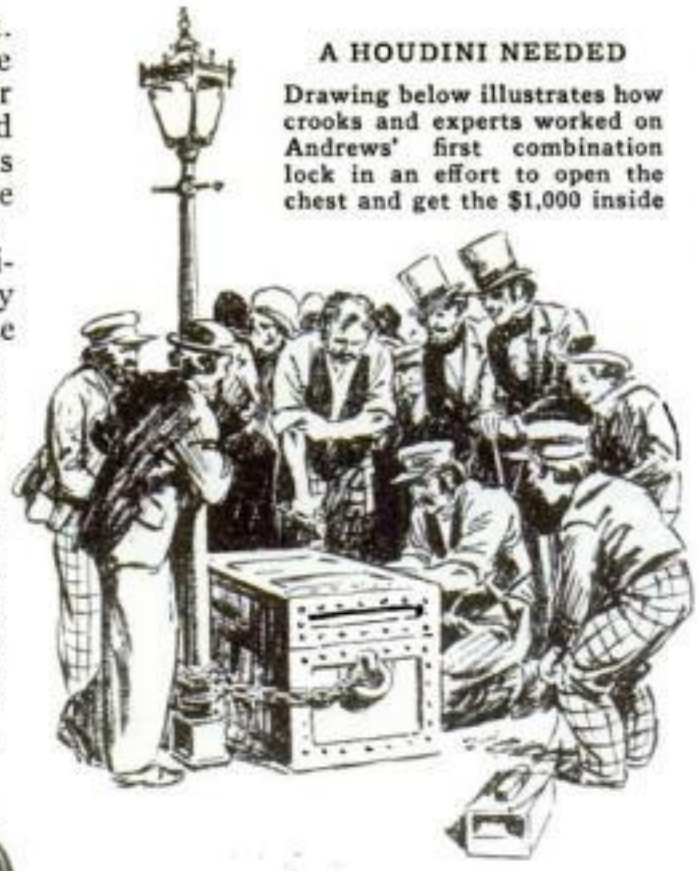
The craft was finished and inflated in the summer of 1849. Later the inventor wrote that she "was kept full five weeks and experimented on in the building, but the vessel was never taken out of the house. From these experiments much was learned, and new food for study and reflection was obtained, and profited by."

That his first experiments did not shake his belief in his theories was shown in Dr. Andrews' later work. His unwillingness to take the ship into the air probably was due to conditions arising from faulty construction; such as, for instance, the fact that, with the envelope partly empty, the remaining gas would collect in the high end and throw the machine out of balance. The work, however, was by no means lost, for the ship which he built fourteen years later owed much of its success to these early experiments.

In the intervening years, Dr. Andrews was too busy with his medical work and other matters to give much thought to his

A HOUDINI NEEDED

Drawing below illustrates how crooks and experts worked on Andrews' first combination lock in an effort to open the chest and get the $1,000 inside



In center, the key Andrews invented for his combination lock; above, his mail sack lock

airship beyond evolving for it the name of "Aereon," a combination of aero and eon —the age of air.

Much of his time was devoted to the growing country-wide business which his combination lock had brought him. This he had invented almost twenty years earlier. In older locks, the bit of the key—the projecting part that operates the mechanism—was made in one piece with the shank, or stem. Dr. Andrews was the first man to make this bit in detachable sections, and to construct the lock itself in such a way that it could be worked only if the sections of the bit were slipped on the stem in a certain order. After the key was turned, the sections were removed, and the lock could then be opened only by a person who knew the combination; that is, the order in which the sections should be slipped on the stem.

THIS invention was tested under dramatic circumstances. In 1832, Dr. Andrews built one of his locks into an iron chest in which he placed $1,000 in cash. Then he had the chest chained to a lamppost at the corner of Broad and Wall Streets, New York. Anyone who could pick the lock was welcome to the $1,000.

The lock-pickers were baffled. The chest was left chained to the post for a month, and in that time hundreds of rival experts tried their hands at it and failed. This success brought him fame and a flood of orders. At his lamp factory in Perth Amboy, he began the manufacture of bank locks and vault doors. In the next ten years, he supplied nearly 200 banks from Maine to Mississippi and as far west as Michigan.

Then the Post Office Department asked him to make an unpickable padlock for mail sacks. This he produced and patented in 1840, and in 1842 he contracted with the Department for the supply of all its needs, a contract which he held for thirty years.

The Civil War caused Andrews to resume work on his airship. But not at once. It was to be expected that a man of his public spirit would offer his services to his country, and shortly after the shot on Fort Sumter had been fired he volunteered as a medical officer.

At Harrison's Landing, on the James River, he witnessed the efforts of the newly formed Balloon Corps to make observations from a captive spherical balloon. Suddenly, it occurred to Dr. Andrews that an aereon, flying over the enemy lines and returning with reports, would be an infinitely better means of observation.

Therefore on August 9, 1862, he wrote a letter to President Lincoln. In this he proposed his idea, stated his experience, offered to pledge real estate valued at $50,000 for the success of the venture, and promised to "sail the airship five to ten miles into Secessia (enemy territory) and back again, or no pay."

This was the first step in a long and almost heart-breaking campaign the inventor waged for Government recognition. For some unknown reason Lincoln did not answer the letter.

Undaunted, Andrews wrote a similar letter to the Secretary of War, and was rewarded with a request for drawings and a description. These he delivered on September 1. They were submitted to the Bureau of Topographic Engineers. In a report, made three days later and without Dr. Andrews having been given a hearing, the Chief of the Bureau stated that he was "not fully convinced of the possibility of this method of locomotion." He added that he could not see that the invention had practical utility and was adapted to and needed for the public service.

Dr. Andrews replied: "I intend to build one immediately on my own account, and if successful I shall present it to the United States Government, in the hope that it may shorten the War."

Plans for the new airship showed many improvements over the one built fourteen years earlier. To give greater resistance to vertical motion and, therefore, higher speed forward, the gas was in three pointed cylinders, each thirteen by eighty feet, placed side by side and stiffened by lengthwise strips of wood. From these was suspended a basket twelve feet long by sixteen inches wide. Instead of an ordinary weight, it contained a car running on a track to permit shifting of the balance for control of the angle.

A noteworthy feature of the new ship was that the cylinders were divided into compartments to prevent the movement of gas, an idea now credited to Count Zeppelin and *(Continued on page 123)*

Copyrighted material

By Boyden Sparkes

GARBAGE

ISLAND OF WASTE SLOWLY BURNING

Heat generated by chemicals in rubbish start spontaneous fires which may burst into flames. The deep heart of Riker's Island is burning, and this heat causes the luxuriant growth of the vegetation planted on the dump land

"She's 125 feet above sea level," said old Paddy after I had stepped to a place beside him on the wharf, "and that's no guess. I had some of our engineers measure it with a transit level.

"In the summer," he continued, "we get mostly rubbish and only about fifteen percent ashes; in the winter it's about fifty-fifty, ashes and rubbish. Nowadays with a depression on it doesn't pay to trim the rubbish. As a result there come to the island paper and a lot of other materials that under ordinary conditions would be reclaimed by contractors who buy from the city the privilege of trimming from the scows such stuff as they can use."

FOLLOWING Paddy Hynes around Riker's Island, I got glimpses of some of the still usable things that New York throws away. High up on the dark wall of the boiler room that supplies steam for the big power shovel was the plaster head of a woman wearing the frozen smirk and modish bob that once had embellished the window of a hairdresser. On the wall of the machine shop hung a large mirror in a gilt frame.

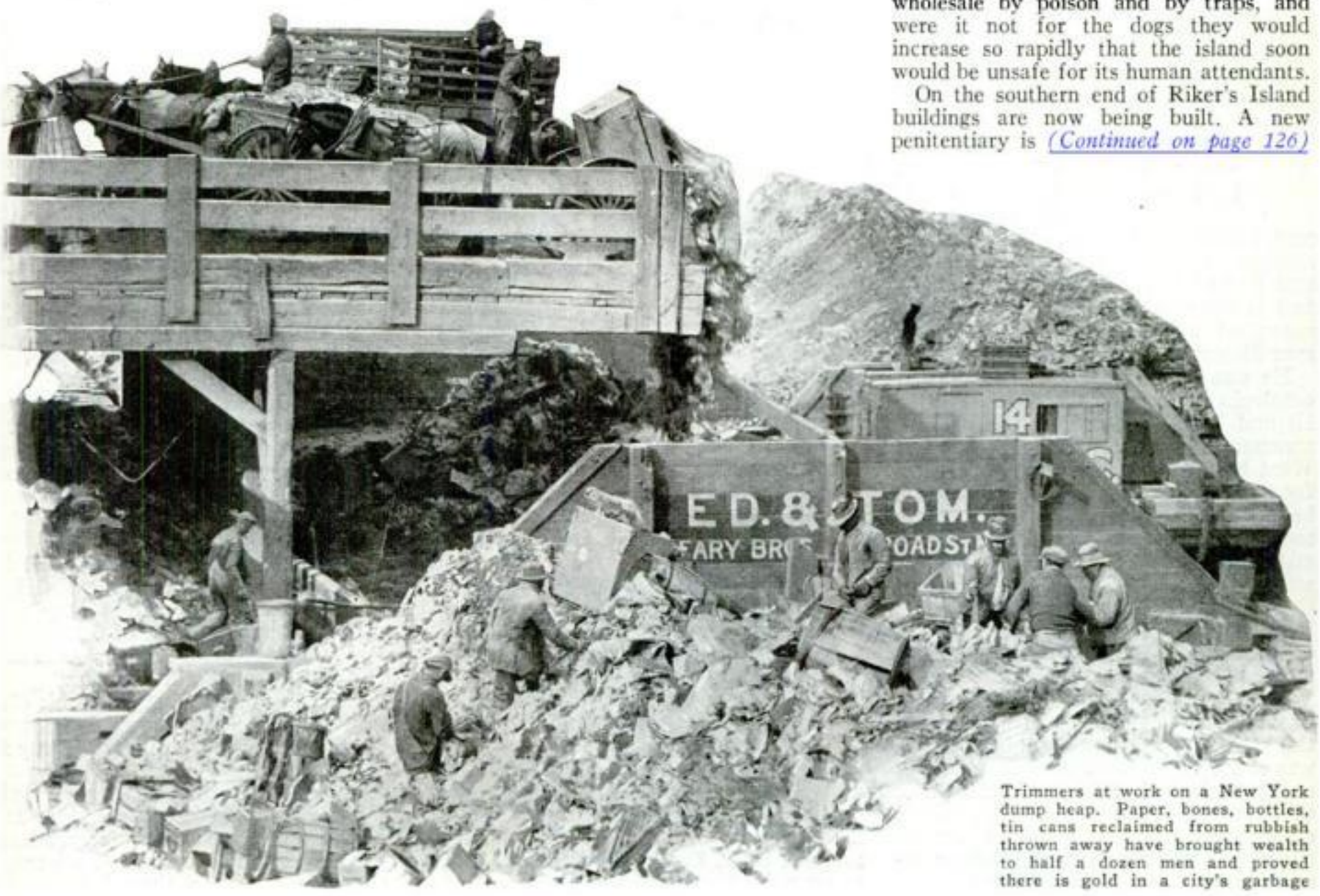
In the pilot house of the tug that brought me to the island I had seen an old-fashioned square-topped piano stool upholstered with red plush. Here and there, among the piles of planks and old boilers stowed between the buildings clustered at the wharf, were a number of trunks.

Fragments of labels bearing the names of hotels and steamship lines testified to the character of the finery once sheltered within those trunks; but now someone had sawed a piece from the side of each of them, and from the interiors came squeaks and whimpers. The trunks were dog houses, and within each dwelt a mother dog and her puppies.

There are about sixty full grown dogs on Riker's Island, and they have a never-ending job. Their task is keeping down the number of rats. Rats get a fat living from the garbage that inevitably finds its way into the rubbish and ashes. There are giants among them, so big and strong that Paddy Hynes and his subordinates long ago wearied of trying to convince visitors of the truth of the fabulous yarns they tell about them. Nowadays they simply point to the rats that seem to fear only the dogs.

There are thousands upon thousands of these loathsome creatures. They thrive in spite of many attempts to destroy them wholesale by poison and by traps, and were it not for the dogs they would increase so rapidly that the island soon would be unsafe for its human attendants.

On the southern end of Riker's Island buildings are now being built. A new penitentiary is *(Continued on page 126)*



Trimmers at work on a New York dump heap. Paper, bones, bottles, tin cans reclaimed from rubbish thrown away have brought wealth to half a dozen men and proved there is gold in a city's garbage

Copyrighted material

Barnum Brown, left, excavating one of the nine dinosaurs that constituted greatest fossil find in history

PRICELESS *Scientific Treasure* UNEARTHED IN Montana Badlands

SEATED at an old-fashioned roll-top desk in his office in New York City, a modest, middle-aged, bespectacled man, looking more like a banker than an explorer, calmly told me the other day that he had just made the largest single find in the history of fossil hunting and unearthed one of the greatest treasures ever discovered by science.

He was Barnum Brown, famous paleontologist of the American Museum of Natural History. Naturally, he did not announce his achievement in those words. What he did in our talk was to disclose for the first time that, a few weeks ago, he returned from the West with the skeletons of nine huge dinosaurs, approximately 80,000,000 years old and each about the size of a rhinoceros, which he dug up in the Badlands of Montana. Never before have so many of the giant denizens of the foreworld been uncovered by one explorer in one dramatic "strike."

That, in itself, would have been enough to reward a lifetime of digging and crown the career of any fossil hunter. Yet, it was only part of the amazing haul that is certain to form the subject of enthusiastic comment and lively discussion in scientific circles throughout the world as soon as the results of Brown's record-making expedition become generally known.

Near Cameron, a little trading post on the Colorado River in Arizona, Brown disinterred the remains of a strange, extremely ancient reptile. In perfect condition despite the fact that it had lain buried in the rocks for 185,000,000 years, it is the most nearly complete skeleton of that remote age ever found on this continent. The creature, about three feet long, with a skull the width of a man's hand, has not yet been classified, though many of its characteristics indicate its relationship to the alligator.

An authority on comparative anatomy with whom I discussed this discovery later told me that, in his opinion, this reptile is the long-sought missing link between the dinosaurs and the crocodiles.

Even that was not all. In the depths of a cave, fifty miles from Carlsbad, N. M., under heaps of bones of extinct animals, including camels, musk oxen, horses, bison, and birds, Brown discovered a single arrow point that furnishes further proof of his theory that men inhabited America from 15,000 to 20,000 years ago.

That conclusion the scientist reached three years ago (P.S.M., Jan. '29, p. 42) when he excavated a herd of extinct bison from a quarry at Folsom, N. M., and among the skeletons found seventeen well shaped arrow points.

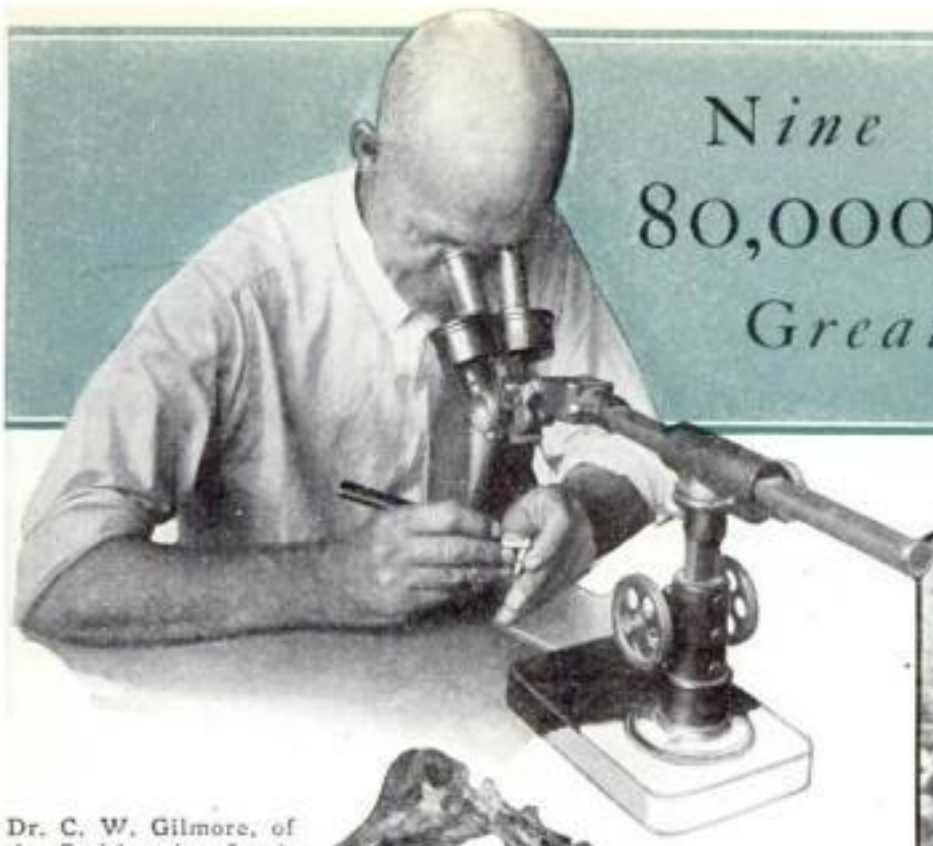
ALL this the scientist accomplished in the short space of four months! He left New York at the end of May and returned in the latter part of September. Before leaving he promised officials of the Museum to "get them a dinosaur."

It was this promise that led to his discovery of the nine dinosaurs, biggest find of its kind on record. This was the way it happened:

"You see," he explained, "the American Museum is making preparations for the opening of a great new dinosaur hall. My colleagues said they needed one more good specimen. I told them I would go

Copyrighted material

Nine Complete Skeletons of 80,000,000-Year-Old Monsters *Greatest Fossil Discovery*



Dr. C. W. Gilmore, of the Smithsonian Institution, examines tiny fragment of bone found in Wyoming Badlands

By

ROBERT E. MARTIN

out and get them one in short order. The fact is, I had one safely tucked away in Montana. Three years ago I was working about fifty miles south of Billings when I came upon a fine specimen of a dinosaur. I didn't have enough time to dig it up so I covered it carefully with clay, just as a dog buries a bone. Under those circumstances, it was easy to promise the Museum a dinosaur.

"Three of us went out to Montana; P. C. Kaisen, my chief assistant in the field; E. B. Lewis, a naturalist from Yale University; and I. At Billings we were joined by a local man, Darwin Harbicht. Sure enough, the beastie was still exactly where I had left it. While we were digging it up, we came upon the skeletons of three others. That made four. Shortly afterward, we discovered five more, making nine in all."

This harvest gleaned by Brown appears all the more amazing when compared with the scanty material resulting in many cases from years of patient effort on the part of other fossil hunters.

ONLY the other day, Dr. C. W. Gilmore, paleontologist of the Smithsonian Institution, Washington, D. C., told me that in more than thirty years of digging he had never had the good fortune to find an important entirely complete skeleton until his trip to Bridger Basin, in the Badlands of Wyoming, a few months ago. There, among other finds, he unearthed the complete skeleton of an *Hyrachyus,* a small, primitive rhinoceros, and an *Orohyppus,* a tiny horse which once roamed our western plains.

On that same expedition, Dr. Gilmore had another piece of "hunter's luck." "We had packed our equipment in the truck and were driving back to camp for the night one evening," he told me, "when on the way we stuck in the partly dried bed of an old stream. I asked one of the men to get some flat rocks lying near by, thinking to lay them under the wheels of the machine as a pavement. When he turned the first stone over, the man discovered a well-preserved crocodile's skull."

Above, applying plaster of Paris bandages to fossilized skeleton of rhinoceros. At left, reconstructing a Diplodocus in the National Museum

There are other such instances of accidental finds of fossilized animal skeletons, but the majority of fossils are found by hard work with pick and shovel. Every year, small parties of scientists go out on expeditions, seeking to find fossil remains that will aid them in their effort to trace life back to its original sources. These men do not dig at random. Their operations usually are based on a carefully planned campaign. To begin with, fossils can only be found in certain geological formations. It is only in places where the carcasses were buried by some upheaval of the earth soon after death that fossils are found.

Through the ages, certain of our western areas were tossed about by mighty cataclysms of Nature like earthquakes and erupting volcanoes. Such relatively rapid changes in the character of the country buried much of its animal life and led to the formation of fossils.

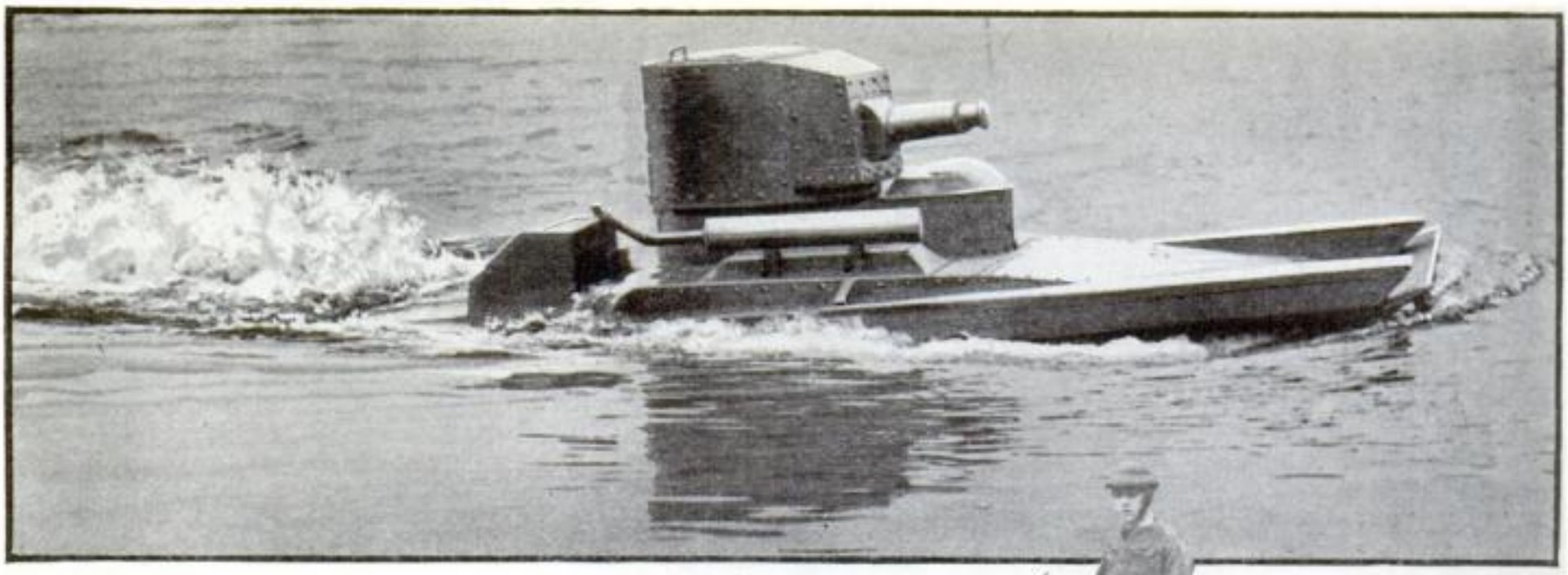
Typical of excellent fossil hunting territory are Bridger Basin, Wyoming, and Hagerman, in Idaho, the scenes of the Smithsonian Institution's two latest field expeditions, both of them regions of sand and limestone interspersed with layers of volcanic ash.

In pictures of these sections, dark streaks on the sides of the hills indicate that, ages ago, torrents sheared through the hillsides, laying bare successive strata of soil. These strata really are pages of history, forming a book that is closed to the average man. This history book is divided into chapters which the geologists call periods. In each chapter is written the story of an individual phase of animal life.

WHEN an expedition reaches the scene of its operations, work is begun by carefully examining the edge of the layers of soil. When the nature of the surface and its stones and gravel show that the layer is representative of the right period of history, digging starts.

Day after day the work goes on, with hardships and privations forgotten in the excitement of the search. When the bone level is reached and specimens begin to appear, the workers can scarcely wait until the find is uncovered, yet the labor of exposing it completely, as Brown told me, may run into weeks of time. No attempt ever is made completely to unearth a specimen at once. As soon as its bones begin to show through the earth, a channel is cut around them. Then burlap bandages soaked in plaster of Paris or flour paste are spread over the cutting. When the bandages have *(Continued on page 118)*

Copyrighted material



WAR TANK FOR LAND OR WATER

So THAT an Army tank may cross a stream where there is no bridge, strange amphibian models have been constructed here and abroad. Latest of them is this British vehicle, which exhibited its tricks before English army officials in a recent demonstration near London. It can travel overland at forty miles an hour, and attains a six-mile speed in the water. The new machine crossed the River Thames successfully in trials. Occupants enter and leave through a hatchway in the top of the gun turret, above the level of the flat deck and the two supporting pontoons. The exhaust is above water to guard against flooding. The photo above shows the tank in the water; that at right climbing onto land.

Motor trucks transporting supplies on big airplane-carrying ship

USE TRUCKS ON BIG SHIPS

WHAT are believed to be the only ocean-going motor trucks in existence are carried in the big aircraft carriers *Lexington* and *Saratoga*, of the U. S. Navy. On these great ships trucks are used to handle supplies and to service the airplanes. Each carrier has two trucks besides a number of tractors. These vehicles are especially useful when stores are coming aboard or being discharged.

TRAIN GERMANS FOR GAS RAID

TO TRAIN civilians against a poison gas attack from the air, a mimic gas raid was staged recently in Bremen, Germany. It was assumed that the city was enveloped in gas and the authorities called for help. Members of the Red Cross, Automobile Association, and Sanitary Corps came to the rescue in gas masks.

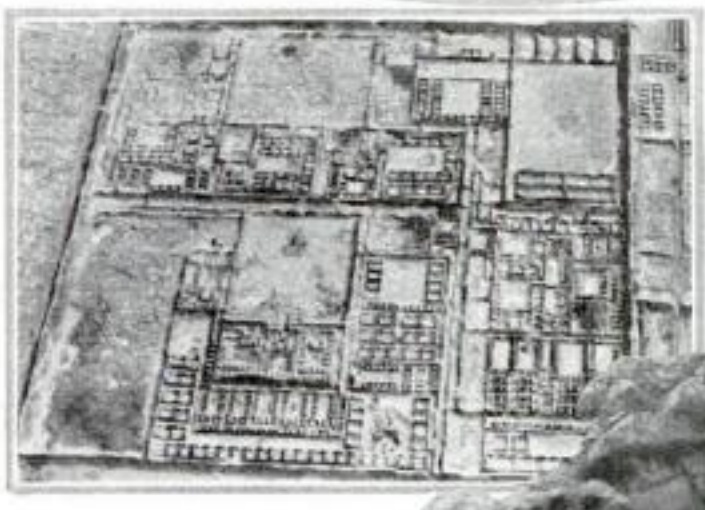
Emergency squad at work in mimic gas raid. At left, victim of attack is carried to ambulance

Copyrighted material

First Photos of Peru's Great Wall

© Aerial Explorations, Inc.

At right, air view of Peru's Great Wall showing how it passes into the heart of the Andes. Above, explorers' plane after smashing against stone wall. At center are leaders of the expedition, George Johnson, elbow on engine, and at his left young Robert Shippee. Below, map of route followed by the two explorers



At left, an air photo of the ancient palace city, Chan-Chan, which was built long before the Incas arrived

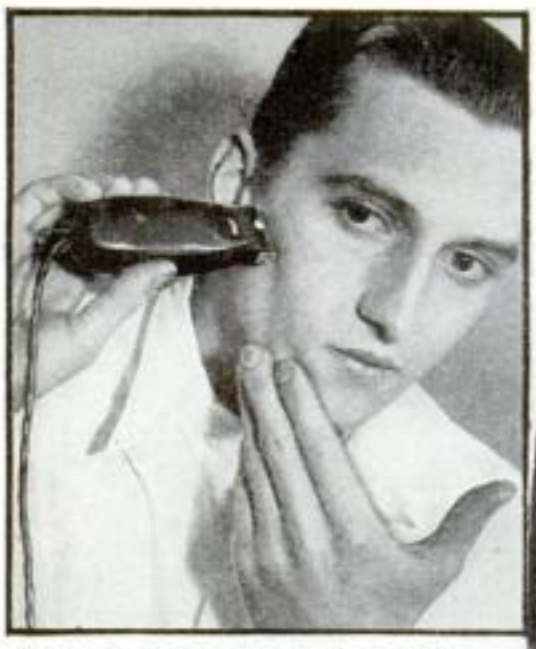
FIRST photographs of the amazing "Great Wall of Peru," discovered not long ago by the Shippee-Johnson Expedition in South America, dispel all doubts that this world's wonder actually exists.

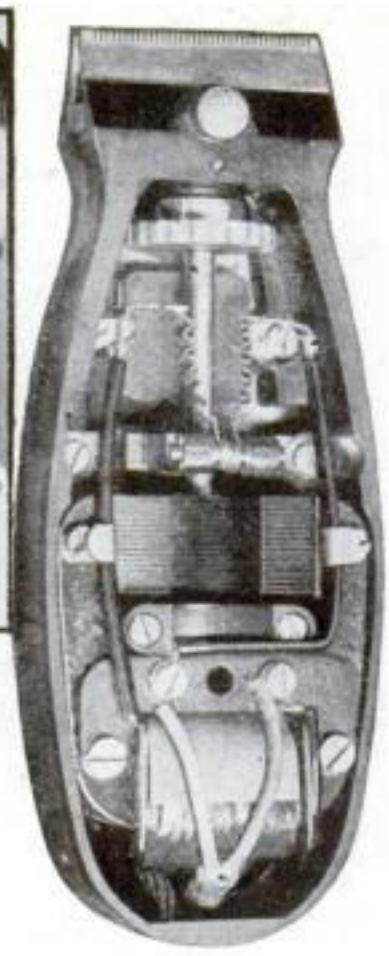
By foot and airplane, the two youthful American explorers traced its course from its beginning, near the seacoast town of Chimbote, for forty miles through the Andes until it disappeared in a mass of mountain peaks and ridges. Made of stones cemented with adobe, the barricade rises at some points thirty feet high. It is believed to have been erected at the dawn of the Christian era by the Chimus in a vain attempt to protect their highly cultured civilization. Discovery of the wall, resembling China's famous rampart, was the climax of a trip in which the explorers came unscathed through an airplane wreck and a revolution.

Robert Shippee, twenty-year-old discoverer, inspects the Great Wall which in places rises some thirty feet high

Copyrighted material

New Powered Razor Shaves Without Lather





Above, electric razor shaving without lather. At right, case opened to show the tiny motor that runs it

JUST placed on the market, a remarkable new type of razor requires no lather. It is run by electricity, plugging into any lamp socket. When this device is held at right angles to the skin and drawn across the face, it is said to give a clean shave without injuring the most sensitive complexion. Its principle is a combination of shearing and nipping, and it removes hairs by the rapid vibration of the inner of two parallel slotted plates. These slots are just large enough to permit the entry of a hair. The case, containing a one-ninetieth horsepower motor, is compact and weighs eight ounces. No replacement of blades is necessary. Development of the device required two years since the demonstration of the first experimental model by its inventor, Col. Jacob Schick, who served in the U. S. Army during the World War (P.S.M., July '29, p. 68).

MECHANICAL TREE LETS YOUNGSTERS CLIMB

Now city children can have the thrills of scaling trees, without the attendant danger. A new "mechanical tree" enables them to climb to their hearts' content. The device is a pole of stout metal tubing, about twelve feet high, from which project handgrips covered with nonskid rubber. It rocks like a swaying branch, safely held by heavy coil springs and a shock absorber in its base.

ELECTRIC EYE MAKES NEWSPAPER CUTS

NEWSPAPER readers in small towns may soon see their favorite sheets as profusely illustrated with pictures as the big metropolitan dailies. This is made possible by the invention of a photo-engraving machine that makes "cuts" for printing at a fraction of the cost and in one tenth the time of the older method.

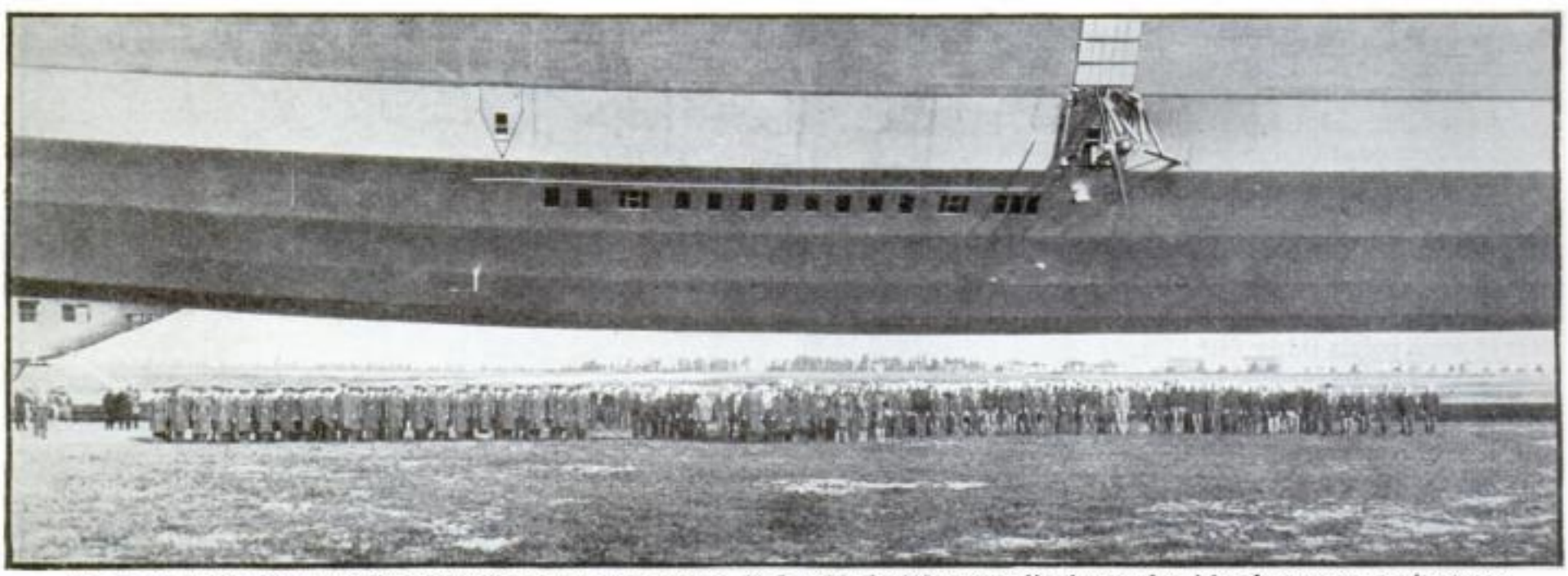
The new machine, by means of an electric eye, transforms a photograph directly into a cut, without any intermediate steps. About the size of an office desk, the device resembles the apparatus used to transmit pictures by wire.

A picture to be reproduced is placed upon a cylinder at the right of the machine, as shown in the illustration at right, and a sheet of zinc upon another cylinder at the left. As the electric eye registers the lightness or darkness of the picture, section by section, a moving stylus of steel automatically engraves the image on the zinc.

Thus the new machine eliminates rephotographing a picture upon metal to produce a cut for printing. Chemicals and elaborate acid etching processes are also dispensed with.

AKRON SETS RECORD BY TAKING 207 ON FLIGHT

A NEW record for the number of persons carried aboard a single aircraft was established the other day when the Navy's giant new airship *Akron,* which has satisfactorily completed several trial flights, took two hundred and seven aloft, starting and ending its flight at Lakehurst, N. J. Seventy-six were members of the crew; the rest, invited guests and student officers and marines. The photograph shows the entire crowd lined up and ready to board the airship, its great hulk only partly visible. The big ship carried the record passenger list on a 500-mile trip over New Jersey.



The giant airship *Akron,* moored outside its hangar at Lakehurst, N. J., with the 207 persons lined up and waiting for an opportunity to go aboard. This remarkable flight set a new world's record for the total number of passengers carried aloft by any variety of aircraft

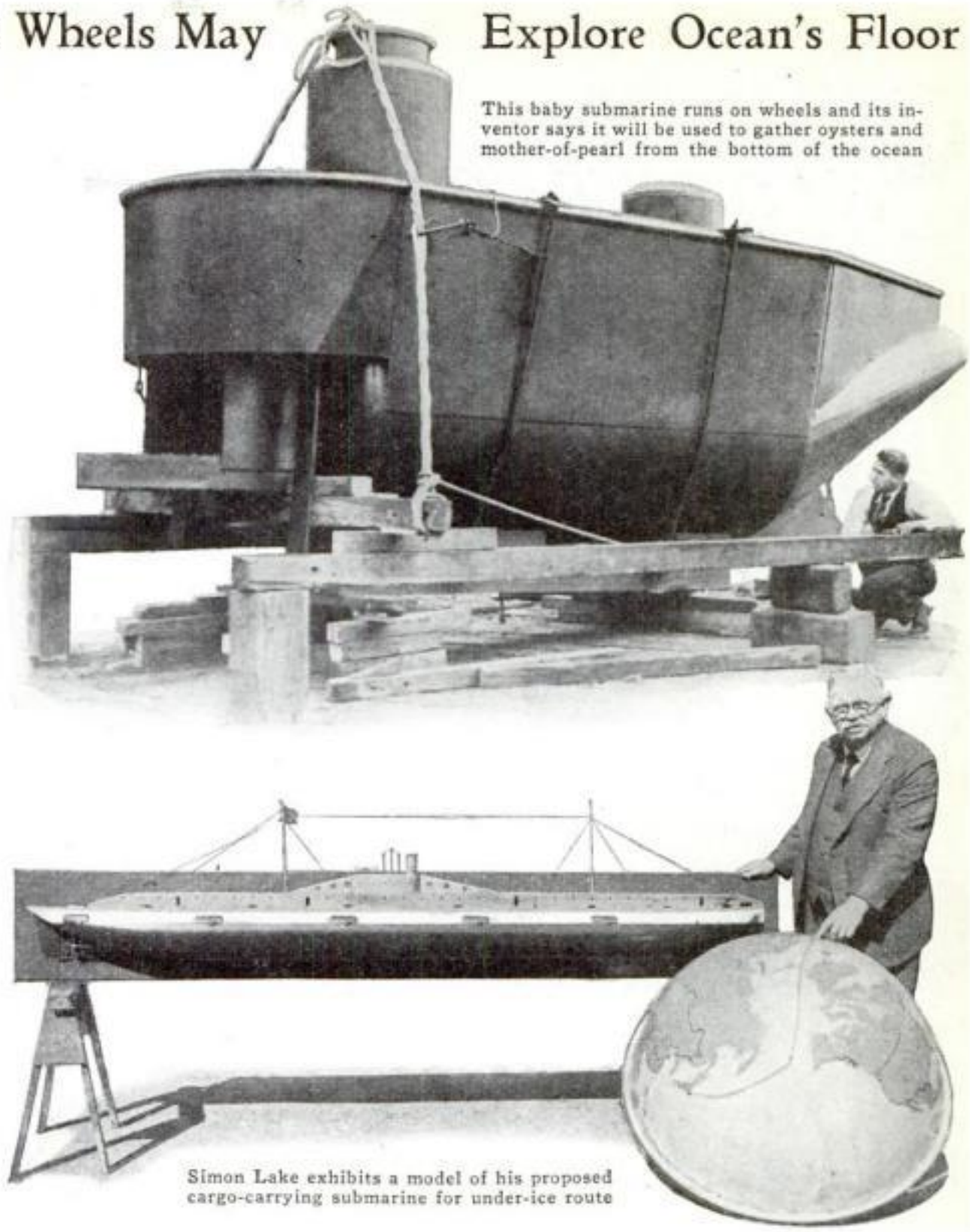
Copyrighted material

New Submarine on Wheels May Explore Ocean's Floor

AN AMAZING baby submarine on wheels has just been constructed by Simon Lake, pioneer American submarine builder of Milford, Conn. With this strange twenty-two-foot vehicle, the inventor proposes to supplement on a large scale his early experiments in exploring the sea bottom in a submersible craft. It may have practical value as well, for Lake told POPULAR SCIENCE MONTHLY that he would attempt to use it in gathering oysters, mother-of-pearl, sponges, and abalone from the ocean floor. Its wheels will enable it to roll along the bottom like a submarine automobile, with buoyancy so reduced that it will not tend to rise.

Another project of this prolific inventor is a huge cargo-carrying type of submarine 400 feet long, which would open new trade routes beneath the ice packs between distant countries. Recently he exhibited a model of such a craft, with collapsible stacks, radio mast, and periscope for under-ice navigation. In a voyage from Liverpool to Japan, he points out, such a craft could take an almost direct route via Greenland and Alaska, substituting a 6,000-mile voyage for the usual one of more than twice the distance by way of the Panama Canal. The practicability of navigating a submarine under ice was demonstrated by Simon Lake as early as 1903. In the winter of that year Lake cruised beneath an eight-inch thickness of ice which covered Narragansett Bay, Rhode Island, in his experimental submarine *Protector*.

This baby submarine runs on wheels and its inventor says it will be used to gather oysters and mother-of-pearl from the bottom of the ocean



Simon Lake exhibits a model of his proposed cargo-carrying submarine for under-ice route

MUSIC SHINES IN DARK

SO THAT singers can read their music in the customary darkness of television broadcasting studios, a New York radio artist has devised self-luminous manuscripts. The music is printed with radium ink on black paper, and the notes shine in the dark.

UNCLE SAM NOW ISSUES PATENTS IN COLORS

BRIGHTLY colored pictures now relieve the drabness of Uncle Sam's copies of patents. Since Congress has authorized the patenting of new flowers, this is the only way to describe the blossoms where the color is a part of the "invention." The first two colored patents are for a yellowish carnation and a deep-pink rose.

ELECTRIC FLOWERS LOOK LIKE THE REAL THING

ELECTRIC flowers are a recent innovation in decorative art. They are intended for use in private rock gardens, and in exposition buildings, theater canopies, and display windows. By inclosing a lamp bulb in a glass hood and a petal-shaped reflector, a striking imitation of a flower is obtained.

HOME BANK INSISTS ON GETTING COIN A DAY

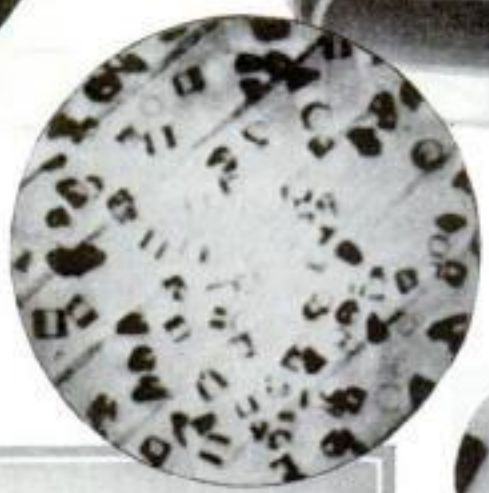
TO ENCOURAGE thrift, a new savings bank for the home reminds its owner if he has neglected to insert a coin each day. The top of the bank is covered by a paper calendar and a transparent, slotted guide through which the money is deposited. Placing a coin in the bank automatically tears a line across the date on the calendar, canceling it. An uncanceled date that has gone by, remaining in plain sight on the calendar, calls attention to the fact that the self-imposed task of saving has been neglected.

Copyrighted material

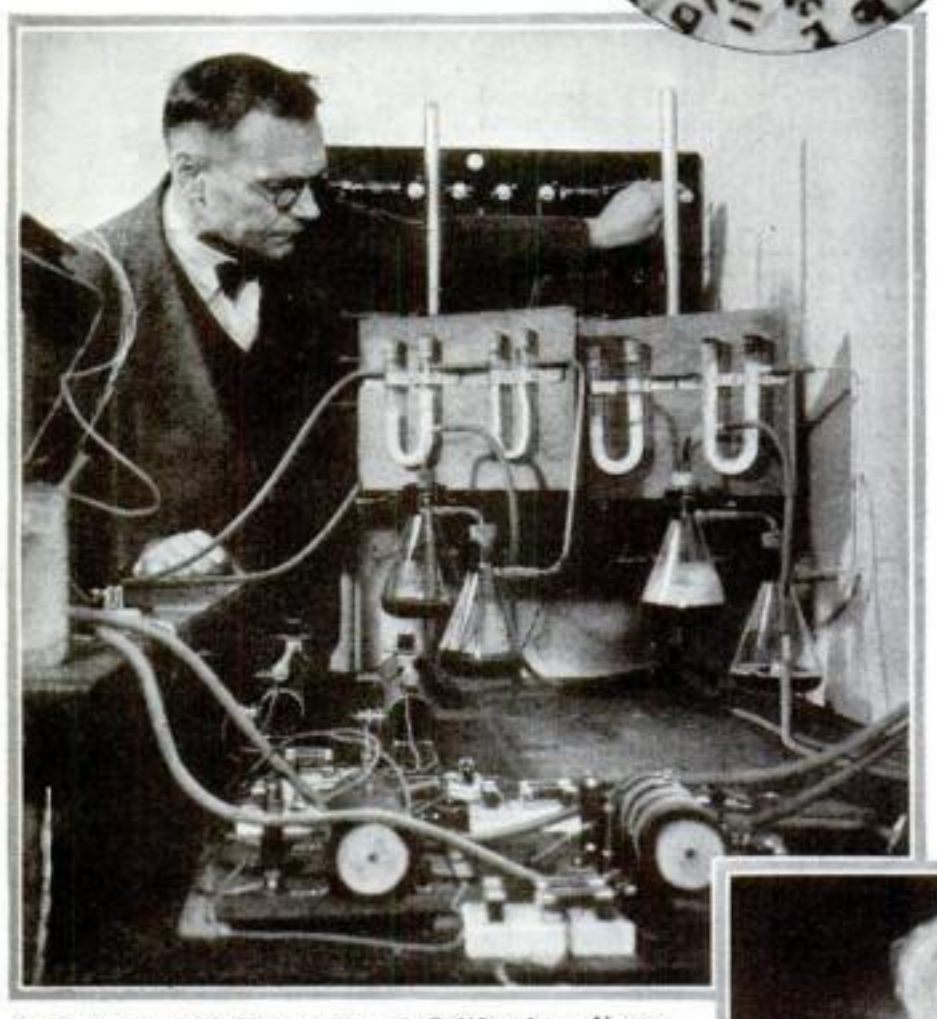
FOR THE FIRST TIME

Snowflakes Are Made to Order

How Nature forms snowflakes of such fragile beauty as the one shown above is no longer a mystery. Using a method that produces them artificially, their shape at birth is now studied. At right, newborn flakes on glass with rulings four one-thousandths of an inch apart



Top, simplest possible snowflake seen as a six-sided figure and in center side view of same flake. Bottom, twin flake



Prof. Adams, of University of California, adjusts apparatus that mixes two streams of air to produce man-made snowflakes. This process rarely occurs in Nature, but it successfully duplicates a snowfall

At right, preparing the refrigerating apparatus that cools one air stream in the snow generator. With this method many snowflake mysteries have been solved and halos and sun dog theories given support

Below, watching, through a microscope, the birth of an artificial snowflake. These flakes, created by chilling a current of moist air, fall into an observation chamber where they settle upon a glass screen, lighted from the top so they can be seen under a powerful lens and photographed while growing

HOW a snowflake's fragile beauty is formed out of thin air is no longer Nature's mystery. First man to see that strange drama, the birth of a snowflake, is Prof. John Mead Adams, University of California physicist, who has devised a way to produce artificial snowflakes and watch them grow.

To mimic Nature's process, Adams mixes two streams of air, one dry and cooled below freezing temperature, the other warmer and moist. Snowflakes form and fall into an observation chamber. They settle upon a glass plate ruled with measured lines, where they may be observed or photographed with the aid of a microscope.

A snowflake is first visible as a crystal less than four ten-thousandths of an inch in diameter, so small that fifteen of them in line would scarcely span the width of a human hair. Its shape, according to Adams, is that of the "simplest possible snowflake," a six-sided prism about as broad as it is high. In growing, the snowflake retains this shape until it is at least ten times its original size. Occasionally in the early stages of a snowflake's growth, two crystals join to produce either a longer prism, often with an internal cavity like a diseased tooth, or a T-shaped form.

These revelations give support to theories that explain solar halos and sun dogs. The first has been ascribed to refraction of light by sixty-degree prisms of snow floating in the air, and the second assumes the presence of T-shaped crystals falling vertically because of their shape. Both forms are now proved to exist as a result of Adams' work.

Copyrighted material

Stone Map Guides to Buried Relics

Secrets of Old Race on Catalina Brought to Light as Long Lost Graves Are Found

Map carved on a flat stone has led to discovery of ancient cemeteries

AN ANCIENT chart, carved upon a thin, flat stone, has led to the discovery of a whole series of treasures buried centuries ago by red-skinned inhabitants of the barren Catalina Islands off the coast of southern California. Found by accident when a hunter stumbled over it, this queer map has revealed the location of a dozen or more ancient cemeteries in which treasures precious to the Indians were buried.

Several caches of Indian relics had previously been unearthed when Ralph Glidden ran across the stone chart on Santa Catalina Island. Its queer pattern of holes excited his curiosity. By a shrewd bit of detective work, starting with the position of the known caches, Glidden located a series of burial grounds.

In the relics discovered, scientists read a fascinating story of the visits of four alien peoples to the isolated island villages. Traces of the coming of the Spanish remain in the form of broken candlesticks, rust-flaked cannon balls, and several heads from once keen battle-axes.

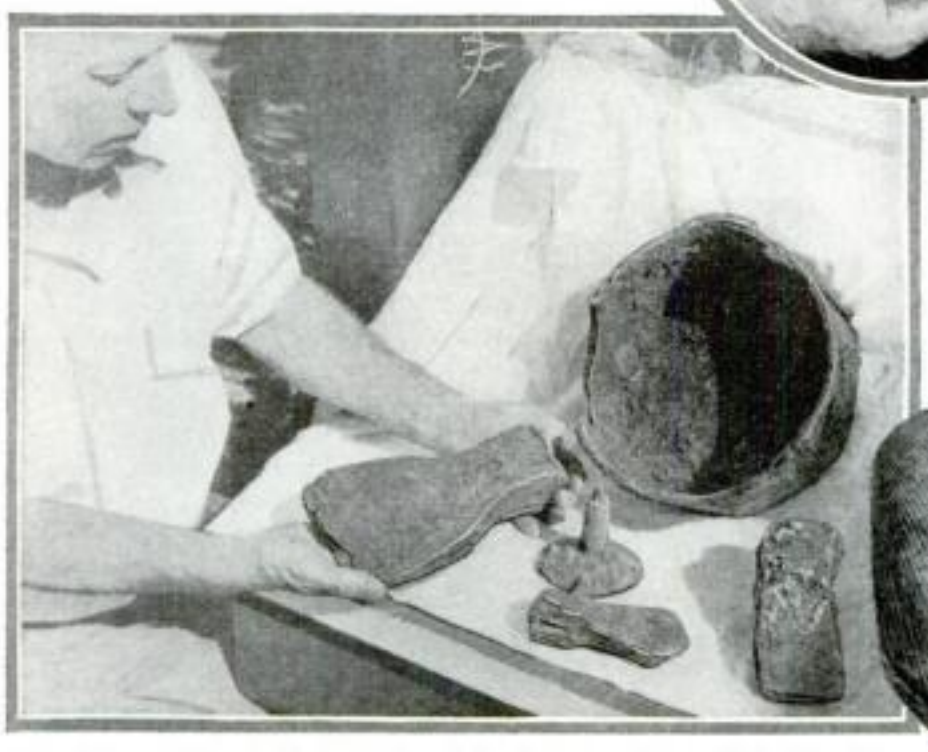
Some of the relics defy the efforts of scientists to identify their uses. One puzzling group includes a number of doughnut-shaped stones, drilled through the center and polished about the edges. One explanation is that they had a place in the religious worship of the natives.

A shallow vessel with a handle and a curious hooked stone are among the unexplained relics that have been unearthed on Catalina as a result of following the directions on the stone map. The use to which these articles were put is unknown

Ceremonial stones, scratched with the sign of the cross, show Spanish influence. Skull is of a giant Indian who was seven feet tall

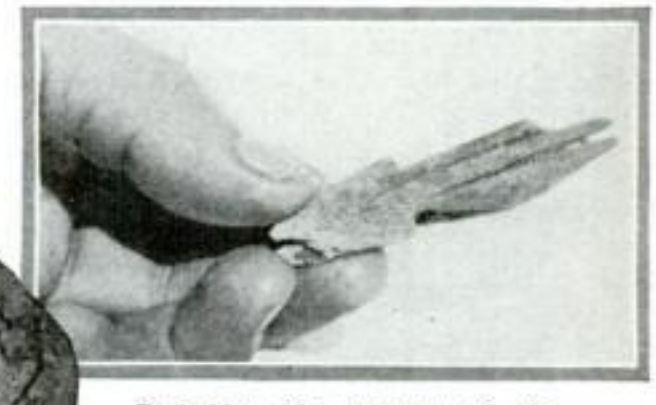
Was this figurine, with distinct Mongolian features, the work of a Chinaman? Found with Indian relics, its origin is unknown

Mysterious stone "doughnuts" on Catalina are a puzzle to scientists



The skeleton of an Indian was found in the grave from which this old Spanish battle-axe, part of a candlestick, and iron kettles were taken

Below, a cutting tool or scraper made from a sea shell and used in dressing skins



Probably this remnant of the bone head of a seal harpoon was used by Indians from the Aleutian Islands who invaded Catalina on some long forgotten fur-poaching expedition before the white man

Copyrighted material

A wind-shy student dropped the stick in a gale and held up her hands as a sign for Jordanoff to take the controls. To cure her of this fear, he also held up his hands and let the ship dive and pitch in the gusty wind

What Pupils Taught Me about

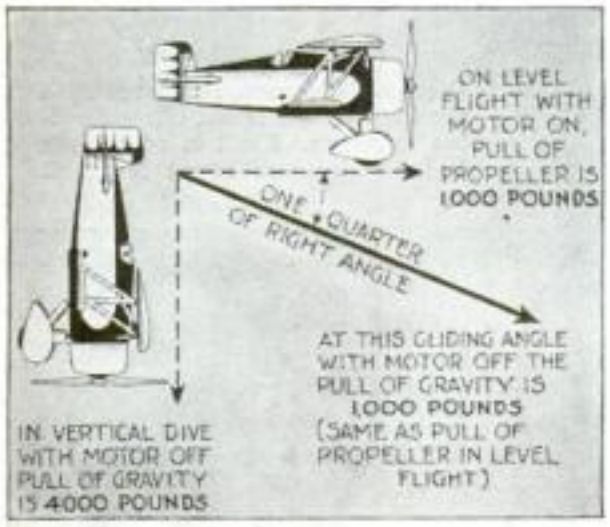


Diagram of level flight and vertical dive, giving the correct gliding angle for safe landing

TWO HUNDRED students have taught me to fly. Their mistakes, the tight corners they got into, the emergencies caused by their errors, taught me as well as them. During the ten years I have been riding in training planes, with greenhorn pilots handling the controls behind me, I have been taking a finishing course in the air.

My two-hundredth student was nineteen-year-old Charlotte Hodgkinson, from Bellaire, Long Island. A few days ago, she set a new world's record by soloing after only two hours and twenty-seven minutes instruction The usual student takes from seven to ten hours, and the previous record for quick learning, according to the newspapers, was held by an Army lieutenant who hopped off alone after three hours and twenty minutes in dual-control machines.

What was probably the strangest ride a pilot ever had helped prepare me for that quick instruction. Incidentally, it answered a question that many readers of POPULAR SCIENCE MONTHLY have asked. Among the hundreds of letters I have received was a recent one from a boy in Montana.

"From your articles," he wrote, "I know every move a flyer makes. I have practiced piloting for hours, sitting on a kitchen chair and using a broom-handle for a control stick. I'll bet I could get into a plane and fly it right off." A score of others have said approximately the same thing.

The latest was a fifty-year-old newspaperman I met a few weeks ago at Curtiss Field. He had seen the great flyers in action. He knew all about the theory of aviation. He understood every movement a pilot makes in the air. He was sure he could climb into a ship and fly it without instruction.

"If you are game," I told him, "I am. Come on over to my plane and I will let you take it up!"

His mouth popped open, but he didn't back out. We slipped on helmets and parachutes. I climbed in the front cockpit and let him sit in the rear. The mechanic swung the propeller and the motor barked. I was off for a ride in a flying machine run by a man who had never sat in a plane before in his life!

OF COURSE, the ship had dual controls. If he began to get into difficulties, I planned to step in and straighten him out. First of all, in warming up the engine, he opened the throttle too wide and almost flew the ship right out of the hangar. On the take-off, he got going in a wide circle. The plane would have piled up in a ground loop if I hadn't straightened up the rudder.

Then, when he took off, he pulled the stick too far back. We shot up like a skyrocket. At a hundred feet, the plane was "hanging on its prop," the nose pointed up at a dangerous angle. I pushed ahead on the stick to prevent a stall and crash.

ON we went around the field, first one wing low, then the other, the ship zigzagging like a drunken bat. Then we started to land. If I had not had controls in my cockpit, my hair would have stood on end. Our path down the sky was like a flight of stairs. We would dive, then pull up, dive and pull up. He couldn't get his gliding angle right. I saw we were either going to "pancake" from fifty feet and wreck the landing gear or crash head-on and wash out the ship. So I took over the controls and brought the plane in.

As we taxied up to the hangar, the reporter grinned sheepishly.

"Theory's all right on the ground," he said, "but it takes experience in the air!" He was right. At least three times in the one flight, he would have wrecked the plane if he had been alone. A mental picture of what should be done is not enough. Only practice gives a flyer the "feel" of the controls—tells him just how far to move the throttle, stick, and rudder pedals in flying. Consequently, in training Charlotte Hodgkinson, I spread the instruction over days, having her practice on the ground between times.

This "feel" of the controls is a flyer's most valuable asset. By constantly bringing it into play, teaching helps develop it. The only way a student learns is by making mistakes. The instructor has to develop a sixth sense, knowing just how far a student can go and avoid a crash; just what a ship will do and what it won't do; just how hard a bump a plane will take and remain intact.

Several years ago, I hopped off from

Copyrighted material

At left, Jordanoff in front cockpit is teaching a student in inclosed rear cockpit to fly blind. Note speaking tube through which instructor gives directions to the student

SHE HOLDS THE RECORD

Charlotte Hodgkinson of Long Island was taught to fly by Jordanoff and she hopped off on a solo flight after two hours and twenty-seven minutes at dual controls

By ASSEN JORDANOFF

Famous Pilot and Aviation Authority

FLYING

Roosevelt Field, L. I., in a blue Travel Air training plane with a student. A couple of miles away, on the other side of the Vanderbilt Speedway, we sat down in a small triangular practice field. I taxied to the far end, swung the ship into the wind, and turned the controls over to the student. He shoved open the throttle, the engine bellowed, and we were off. That is, I thought we were.

JUST as the plane cleared the boundary fence, fifteen feet in the air, the student saw an Army bomber from Mitchel Field cross his path a mile away. The sun was at our backs; the air unusually clear. Under such conditions, objects appear nearer than they are. The student thought he was going to crash into the bomber sure. In a panic, he cut the gun.

Dead ahead, less than a hundred and fifty feet away, was a spur of the Long Island Railroad, a ditch, and telegraph poles. We couldn't clear the poles, and the distance was too short to side-slip off forward speed. Grabbing the dual control stick, I jerked up the nose of the plane. It stalled twenty feet above the ground, the wings mushed through the air, and we slapped down in a hard pancake landing. It almost drove us through the seats, but it stopped the ship, undamaged, less than a dozen feet from the edge of the ditch.

A hundred bad landings with students have taught me just how far I can drop the ship without damaging it. Ground-shy beginners invariably level off too high on first landings, letting the plane pancake down with a thud. Usually, this jarring, vertical descent is for only a foot or two, but one student I remember landed thirty feet in the air. The drop washed out his landing gear.

Knowing just how high I can stall a plane and not wreck it in a pancake landing is only one of the things I have learned from teaching students. Thousands of tail spins, stalls, skidding turns, and side-slips have taught me how far a ship can get off balance and still keep out of trouble.

One of the girls I taught to fly was a crack pilot in calm weather but nervous in wind. To cure her, I took her up in a forty-mile-an-hour gale. At 800 feet, the gusts were tossing the plane about like a cork in rapids. The student shook the stick and held up her hands. That was the signal for me to take control. I realized this was the psychological moment. If she gave up now, the wind would always have her licked.

SO I waggled the stick and held up *my* hands! I looked around and grinned. She kept hers determinedly in the air. So did I. The plane reared and plunged with nobody flying it. I knew I could judge how far it could dive and pitch without losing balance and stuck it out. Minutes seemed to drag by while the pilotless plane bucked its way through the gusty sky. Finally, the student gave in and took the stick. After a complete circle of the field, she landed. From then on, her fear of rough weather disappeared.

Jordanoff, before taking a student up, inspects guy wires to be sure machine is in condition to stand heavy strain

An instructor must know the what and how of flying and be able to explain it so the student can understand. In telling a beginner how to land, for instance, I always try to make comparisons that will come within his experience. If he is a sixteen-year-old boy, I explain that it is just like coasting down a hill and sliding along the level ground at its foot; the plane slides down the air and levels off just before it reaches the field.

If the student is a trained engineer, I go into details. *(Continued on page 122)*

Copyrighted material

Insurance *against* . . . FROM TWINS

By Freeman

Baby swung his milk bottle, knocked out two of father's teeth, and the insurance firm paid

SHORTLY after three o'clock, one recent afternoon, workers in a New York clothing factory rushed frantically into the street. Racketeers, seeking to intimidate the owner, had hurled a huge stench bomb into the plant. So ingenious was this combination of malodorous chemicals that a dozen dry cleanings failed to remove the foul smell from garments valued at $8,000. They were a total loss—but not to the manufacturer.

When the gangsters first made threats, he told his troubles to an insurance broker and received the newest form of protection, racketeer insurance. His claim was paid in full. Between 500 and 600 other American manufacturers, the broker told me, have taken out similar policies.

They form the latest development in the swift-moving expansion of insurance to meet the demands of present-day conditions. Never before has the activity in developing new forms of protection been so great. Experts with whom I have talked pointed out scores of unusual policies being written for the first time—policies based upon the findings of a strange, intricate, exact science of which the average person knows little.

Newly-weds now insure against twins

If you want to insure your vacation against rain, go ahead. Several companies will write you a policy. If you fear to send your shirts to the laundry, you can take out insurance against lost buttons and ripped fabric.

If you buy a dog, you can insure him against biting the neighbors. If you own a store, you can get protection against business failure. If you run a newspaper, you can take out a policy protecting you from libel suits. If you write a book, you can get insurance reimbursing you if it is a flop.

In Pennsylvania, coal mines are insured against fire; at Coney Island, the Ferris wheels carry protection against high winds; in New York hospitals, policies cover precious stores of radium. You can take out insurance against airplanes falling through your roof, against tires blowing out on the highway, and even against the wrong party winning at the polls.

Once, $7.50 worth of white soap was insured for $7,500. A famous sculptor had carved it into figures for an exhibition. Another time, a man in Indiana was so tickled at getting a set of well-fitting false teeth that he rushed out and had them insured. In Virginia, a farmer, proud of a prize ham, protected it with a $1,000 policy. And—believe it or not—half a dozen American couples last year took out insurance against twins!

"Twin insurance," designed to aid in the support of an extra member in the family, is an old story in England. More than a hundred policies have been written there, and two or three times the holders have collected. The premium is five percent of the amount of the insurance taken out, which also covers the birth of triplets.

Railroad brakemen are the poorest risks

Many unusual policies have been written for experts of various kinds. For instance, a tea taster had his tongue insured; a hairdresser got protection for his agile hands and wrists, and an expert blender of rare perfumes took out a policy on her nose to reimburse her if she caught a cold. Paderewski, the pianist, has each finger of both hands heavily insured. Mistinguet, the French dancer, once carried a $1,000,000 policy on her legs, and Charlie Chaplin has his famous waddling feet insured for considerably more than their weight in gold.

Breeders of pedigreed cats and dogs can insure the animals against loss of ability to reproduce, farmers can get insurance against crop failure, litigants can take out policies protecting them against reversal of decisions by a higher court, parents can insure their children against kidnapping, and anyone can get an accident policy that will cover everything from falling off a skyscraper to tripping over a shoelace.

Glance at half a dozen claims paid under such policies during the last year.

A gentleman helped an elderly lady on a street car. She bowed her thanks and an umbrella under her arm poked him in the eye. In Canada, a boy swallowed a "Safety First" badge. In New York, an infant swung its nursing bottle back and forth, struck its father in the mouth, and knocked out two teeth. In Illinois, a young man, dancing with his best girl, collided with another couple. The elbow of one of the dancers broke his nose, and in hurriedly removing his arm from around his fiancée's neck, he tore his thumb on a brooch.

Poetry proved the undoing of a fifth policyholder. Reciting an original epic, with gestures, he lost his balance, fell, and dislocated a hip. Another man reported that he was praying in church when a strange dog wandered in and bit him. In chasing it, he slipped and fell down the steps.

With such strange and unpredictable accidents befalling policyholders, how can insurance companies carry on? How are they able to outguess the unexpected and make a profit at the end of the year? Recall that Voltaire, the French writer, was given just one day to live at birth, was ailing all his life, yet attained the ripe old age of eighty-four; while Sandow, the strong man, scratched his thumb and died of infection in the prime of life.

Recollect that Bobby Leach plunged safely over Niagara Falls in a barrel, then slipped on an orange peel and broke his neck. Remember that a passenger saved from the *Titanic* drowned in a pond in

You can insure your home against plane crash

All Policies Based on Two Strange Laws

Copyrighted material

10,000 Hazards

TO EARTHQUAKES

E. Patterson

New England; and that Louis Strang, dare-devil of the speedway, met death in a touring car when an embankment caved in as he was traveling less than ten miles an hour! With incalculable chance and ungoverning paradox thus busy in the lives of men, how can insurance be anything but a pure gamble? What solid basis can there be for assessing premiums or calculating risks?

The answer, I found, lies in the astonishing work of actuaries, skilled statisticians who trace the working of natural laws more strange, more mysterious, more incomprehensible than those that guide the planets or bring the alternating seasons. Using formulas as obscure to the layman as Einstein's calculations on relativity, these highly paid mathematical scientists marshal their antilogs, geometrical curves, and Napierian logarithms. Before one company issued a new policy, its staff of experts worked for three years compiling statistics from a million data sheets.

Across the street from the office in which this is written, 500 people are working in the actuary department of the New York Life Insurance Company. A few blocks away, in the Metropolitan Life Building, 1,250 others are similarly employed, assembling statistics covering reams of paper with figures and data—subtracting, adding, running through chattering, automatic machines compilations that shed light upon two curious laws, the *law of averages* and the *law of probabilities,* upon which all insurance is based.

How many ships will be wrecked in a year? Insurance experts know exactly

Fire insurance cost varies with location

Nobody knows how many passengers will be aboard the Twentieth Century Limited when it pulls out of the Grand Central Station next Saturday morning. But railway officials can make a pretty good guess on the basis of the average number of passengers in the past.

The famous French naturalist, Count de Buffon, spent days in 1735 flipping a coin and marking down whether it came heads or tails. When he had chalked up 4,040 tosses, he added up the two columns and found heads had come up 2,048 times, almost exactly half.

While Buffon flipped his coin, Wolf, a Swiss astronomer, was throwing dice 280,000 times to study the law of averages and, later, another experimenter drew cards from a deck all day for a week and found the deuce appeared approximately the same number of times in every thousand draws.

The most amazing example of the mysterious working of this little-known law of averages is the following: Shake up a hundred black beans and a hundred white beans in a jar. Then have a blindfolded person pick out two beans at a time. Almost without exception, when all the beans are removed, it will be found he has taken out black and white in the definite ratio of twenty-five pairs of black beans, twenty-five pairs of white beans, and fifty pairs of one black and one white!

Bobby Leach went over Niagara in a barrel but died slipping on orange peel

This strange, hidden law that guides spinning coins and brings out varicolored beans in regular ratio plays its part in all phases of life. Year after year, for example, in white races, there are 104 boys born for every 100 girls. Twins appear once in every 100 births, triplets once in every 7,000, and quadruplets once in every 370,000. Each of us may live to be a hundred or we may die tomorrow, but the *average* goes on just the same. Of 100 children born today, seventy-nine will reach thirty years of age, thirty-nine will reach seventy, and two will live to be ninety.

Every seventh person in the United States meets some kind of accident every year. You may or may not be the seventh person. It makes all the difference in the world *to you.* But it makes no difference at all to the insurance company. If it isn't you, it will be someone else. The ratio holds. The company can count upon the average.

Boy ran against a car and driver was held responsible for the injury sustained

It is this fact that makes insurance possible. Take policies against rain. They seem a pure gamble. Even the Weather Bureau makes mistakes. Yet, in the ten years since rain insurance was introduced in this country, it has become a stable form of business. On particular days the Weather Bureau may be wrong, but year after year its average is right. Insurance companies do business on the basis of the average.

A short time ago, an Oklahoma oil man applied for a policy that would reimburse him if a $30,000 well he was drilling turned out to be a dry hole. No statistics were available on the proportion of gushers and "dusters" in the region, and his request was turned down. Unless an estimate of the average can be obtained and the element of probability calculated, policies are not written.

In some kinds of insurance, the average holds for the whole country. In others, different communities are considered separately. For instance, for automobile insurance, the United States is divided into 540 divisions. Traffic-jammed cities have a higher accident average than small villages, and policyholders are taxed accordingly.

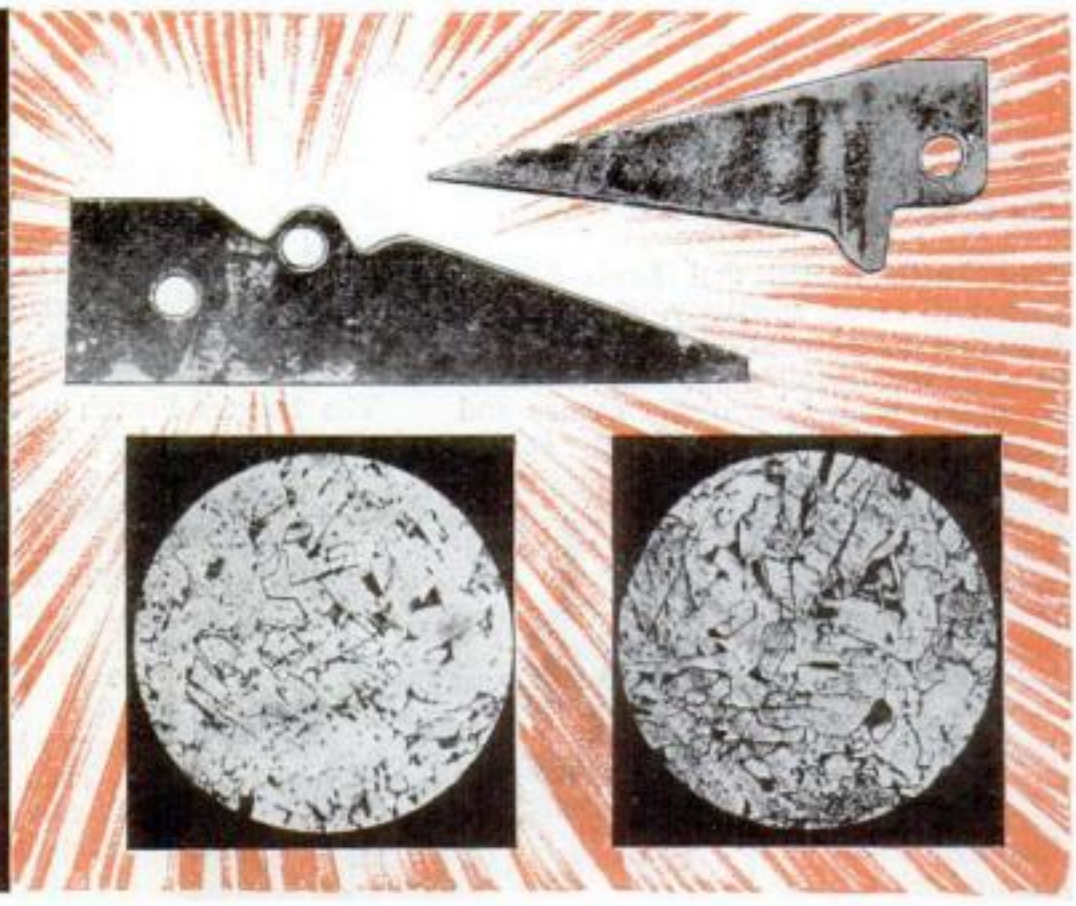
Occupation is the basis for issuing personal accident insurance, with railroad brakemen listed as the poorest risks. The actuaries of the fire insurance companies have worked out their tables for 10,000 classes of hazards, and each class is a different risk, with a different premium. From the rate *(Continued on page 112)*

Nose, Legs, or Teeth Can Now Be Insured

Copyrighted material

Stars *and* Spider Webs

This weapon was produced by a maniac who tried to cover his crime by leaving the mark of a horseshoe on his murdered victim



By making photomicrographs of crystal structure, a scientific detective proved triggers at top were of same metal and thus solved a bomb mystery

REACH into the scientific grab bag. Select the first subject that comes to hand—astronomy, botany, physics, or entomology. The odds are that at this very minute it is being used by scientific sleuths to solve mysterious crimes.

From widely scattered American cities, a score of men whose names are feared and hated by the underworld have told me authentic tales of thrilling captures made by unusual applications of science. Imagine trees solving murders—stars convicting criminals! Imagine gossamer threads, spun by spiders, leading to a startling denouement of tense drama of crime and mystery! Imagine a "sand-grain" of bone, embedded in the lead of a fatal bullet, dragging to light the dread secret locked in the heart of a murderer! Yet, such wonder stories of criminal-catching are actually on record. In gathering material for these articles, I discovered that sciences far removed from ordinary crime detection are playing a part in the work of the modern man-hunter.

Take, for example, the way in which strange bits of botanical evidence, a few years ago, solved the cunningly plotted "Rustic Bridge Murder."

Soon after daylight one morning, laborers in a Pennsylvania town, crossing a park on their way to work, discovered the body of a man lying near the middle of a rustic bridge, a bullet hole through his skull. Police identified the body as that of a leading merchant. The night before, they found, he had played cards with friends until a late hour. When he started for home, he carried in his wallet nearly sixty dollars he had won. Under an arc light, near the entrance of the park, he met an old friend. He appeared uneasy and declared he believed someone was following him. The friend offered to accompany him home, but he refused this proffered aid and walked on alone into the shadows of the park. He was never seen alive again.

Detectives examined the body. The wallet was missing. Robbery apparently was the motive. Beyond that, however, the investigators faced a stone wall. Each of the card players satisfactorily accounted for every minute of the remaining hours of the night after the game broke up. No suspicious characters had been seen near the park after dusk. The mysterious slayer seemed to have come and gone like a phantom shadow, leaving no trace behind.

"A CRIME without a clue," reporters were beginning to call the case when a hawk-eyed young scientific sleuth picked up a bit of fallen bark near the spot where the body was found. This piece of bark, no larger than a postage stamp, gave him the clue through which he unraveled the tangled skeins of one of the most curious crimes on record.

A fragment of what appeared to be yellow hair was caught in the bark. The detective examined it with his magnifying glass. No, it was not hair. It was fiber, evidently from a rope. Carefully he studied the top railings on both sides of the bridge. Opposite the spot where the body had lain, he found a peculiar groove on top of one rustic rail and a small triangular indentation in the wood near it. Below the groove he observed one of the wide leaves of a pond lily, growing in the muddy lagoon, half torn away. With grappling hooks, he dragged the bottom and brought to the surface first the missing wallet, with its contents intact, then a dripping revolver tied with a long rope to a heavy stone.

THE merchant, planning suicide, had taken out heavy insurance to provide for his family. Because the policies would be void in case of death by his own hand during the first year they were in effect, he had taken elaborate precautions to have all evidence point toward a murder. Before firing the fatal shot, he had tossed his wallet into the water, then tied the revolver to the rock which he hung over the outside of the rail so it would drag the weapon to the bottom of the lagoon the instant it pulled from his nerveless hand. Meeting the friend under the arc light had been unexpected, but he had taken advantage of it to add to the plausibility of the murder theory.

The bit of bark, with its attached fiber,

A Christmas box exploded, killing two. The criminal was found by microscopic study of a bit of wood

Copyrighted material

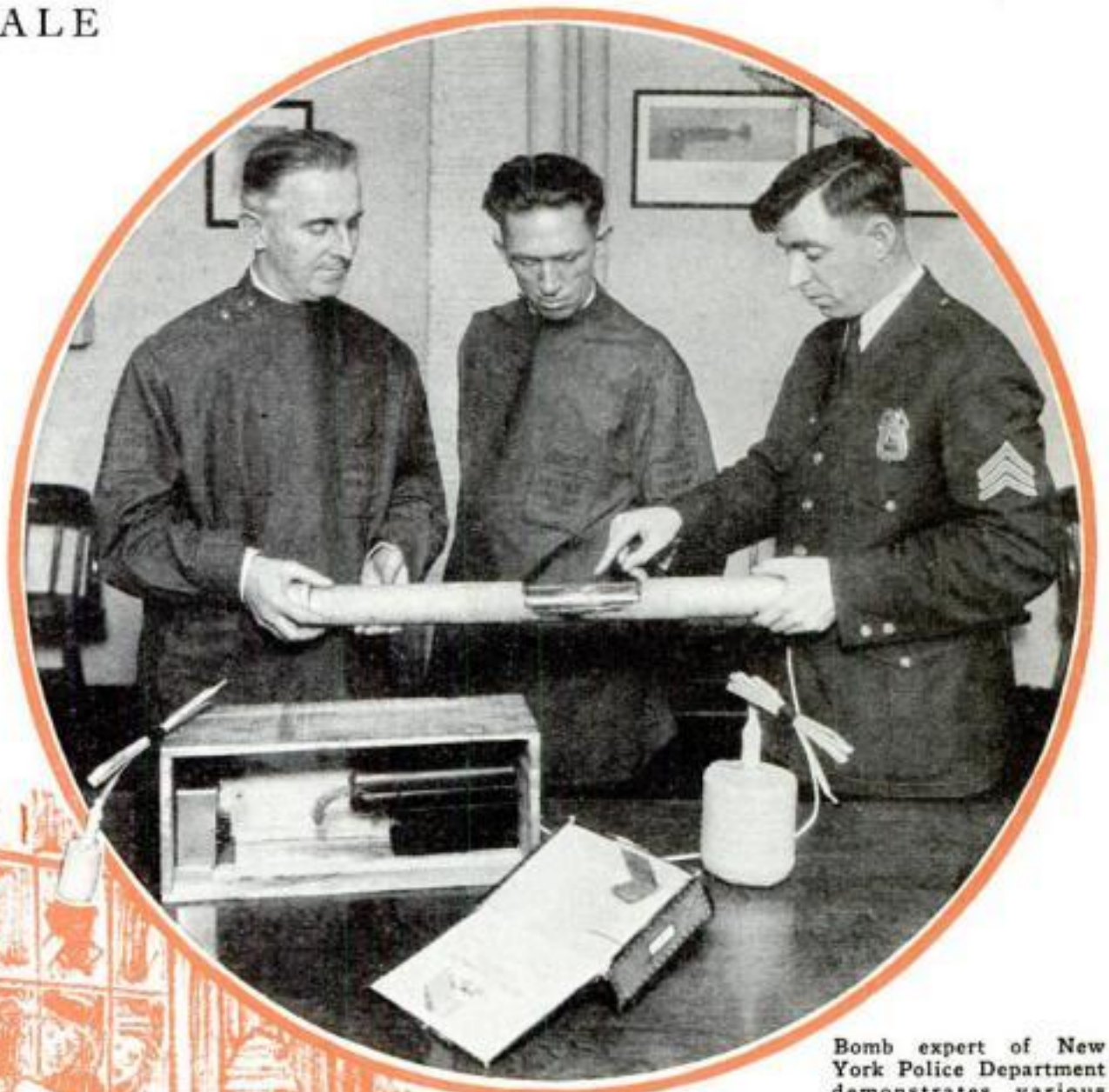
Catch Clever Criminals

By EDWIN W. TEALE

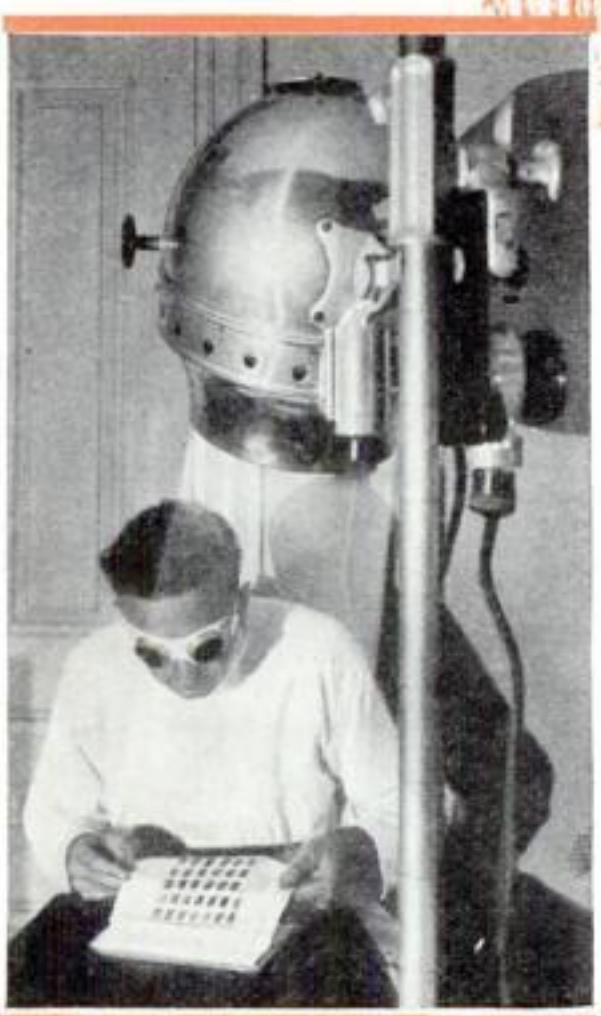
had torn loose as the groove was being worn by the swiftly-running rope and the triangular indentation in the rail resulted from the corner of the revolver handle striking the wood as it jerked over the top. The weapon falling into the lagoon had torn away part of the lily pad. These bits of evidence, recorded on bark and wood and leaf, had upset this strangely tragic and almost perfect plot to defraud the insurance companies.

IN OTHER cases, master sleuths use a profound knowledge of botany to ferret out secrets of crime. From the smallest fragment of a leaf or the most minute particle of fiber, the skilled detective is able to determine the plant from which it came. By the cellular construction of wood, he can tell what kind of tree produced it. Through dried leaves in a pocket, through tiny diatoms in mud on shoes, through sawdust or chips in a trouser cuff, scientific detectives have upset alibis and run desperate criminals to earth.

Once, the celebrated French detective, Edmond Locard, trapped a slayer by discovering in the wax of his ears pollen from a certain flower. This plant bloomed in a particular part of the country near which the suspected criminal swore he had never been.



Bomb expert of New York Police Department demonstrates various types of bombs to Police College instructors



Setting a trap for a blackmailer. Scientific sleuth is observing how stamps, treated with aspirin, glow under ultra-violet light rays

The mysterious murder of this woman in a lonely cabin was solved by a spider web

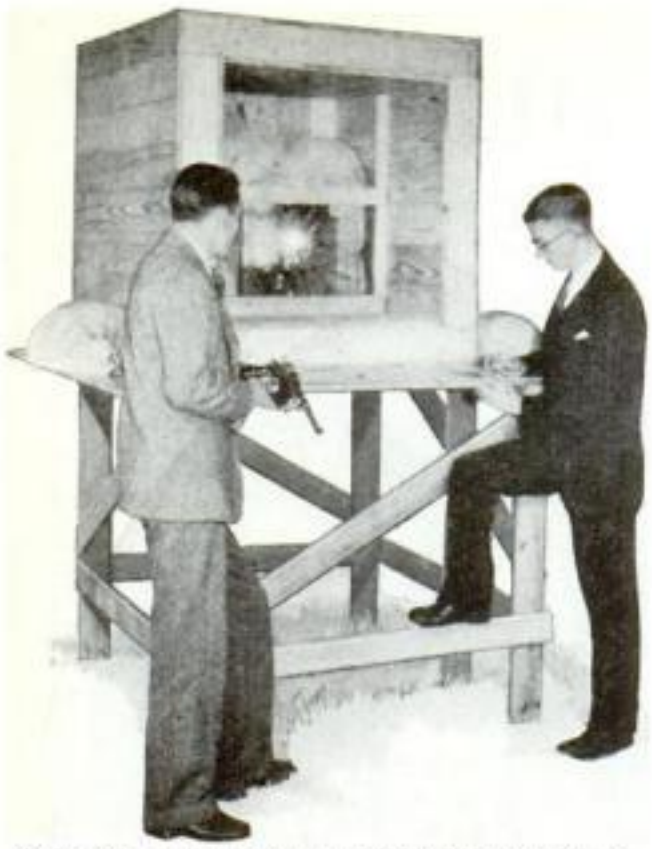
During weeks spent at the Scientific Crime Detection Laboratory, in Chicago, I was told of a curious bit of underworld lore by which a piece of wood is made to carry an invisible message. With a nail or chisel, the criminal scratches the words of a message deeply into the surface of a small board. Then he planes away the wood to the bottom of the indentations. The board is again smooth and level. But where the pressure was exerted to form the letters, the fibers of the wood remain compressed, although this compression is not visible to the naked eye. However, as soon as the wood is soaked in water, the compressed fibers begin to swell and the writing stands out clearly in relief. For such messages, soft maple is most frequently used. Scientific detectives, who recognize the timber of different trees at a glance, are aces in intercepting these "wooden telegrams of the underworld."

IN ALL the instances in which botany has played a part in crime detection, probably the most amazing occurred in Seattle, Wash. A tree solved a mysterious murder. Luke S. May, the noted scientific sleuth of the northwest, who was in charge of the case, gave me the details.

The city had been stirred by the mysterious slaying of an elderly man who was shot to death by someone outside the house as he sat by the window of his study on the ground floor. The hole in the pane had been made by a bullet of large caliber. May knew if the shot had been fired close to the glass, the pane would have been shattered. So he walked back to the sidewalk, looking for clues under a large shade tree which grew at the curb. As he rose from his knees, disappointed, a gust of wind creaked the branches above his head. He looked up and saw an extraordinary thing. Fluttering at the end of a branch was a leaf *with a bullet hole in it!*

Hurrying to the room where the victim was found, he pressed his eye to the hole in the glass and looked through it

Copyrighted material



Scientific tests of shatter-proof glass, used to outwit crooks, are made by the trained sleuths

and the leaf directly into the window of a house diagonally across the street! The detective learned that the man who had occupied that room on the night of the murder had disappeared the next day. But he was able to broadcast such an accurate description of the wanted man that in less than a week he was captured, when he confessed.

In another sensational case, botany joined hands with metallurgy to convict the diabolical sender of a TNT-filled infernal machine.

Through the flat farming country of central Wisconsin, a few years ago, a drainage ditch was under construction. The chairman of the County Board, George Chapman, was directing the improvement. Some of the farmers wanted the ditch; others strenuously objected to the increased taxes. Feeling about the matter was running high in December.

On the day before Christmas, a postman delivered a package sealed with red and green labels at the home of Chapman. Thinking it a present, his wife carried it to the table and leaned expectantly over it while her husband cut the string. A terrific explosion shattered the room. Mrs. Chapman was instantly killed; her husband so seriously injured he died later.

FROM the wreckage of the house, detectives unearthed two clues—a piece of elm wood and a metal release trigger which had been used in the construction of the bomb. On the farm of one of the men who had protested most violently against the construction of the ditch they found a similar homemade release mechanism on a gas engine, and under a box in the toolshed two tiny shavings, pushed there in sweeping out the building.

All this evidence was submitted to Dr. J. H. Mathews, chemist and scientific detective at the University of Wisconsin. He examined the shavings under his microscope and, by their cellular construction, proved they had come from a piece of elm wood. Then he made a painstaking metallographic analysis of the bomb trigger and the gas engine release mechanism and reported that both had been cut from the identical parent piece, a heavy steel barrel hoop! His testimony sent the maker of the bomb to prison for life.

I ASKED Dr. Mathews, when I met him recently, to tell me how he makes such an analysis of two pieces of metal to determine if they came from the same origin. The first step, he explained, is to polish the metal. He begins with a coarse file, substitutes a finer one, then uses six or seven pieces of emery cloth, each finer than the preceding one, and ends with a careful scouring with jeweler's rouge.

After such a polishing, not a single scratch is visible, even under a compound microscope. However, the slightest amount of slag can be seen. If one piece of metal contains slag and the other does not, it is immediately evident that the pieces had different origins. If, however, both surfaces look alike under the lens, Dr. Mathews turns to powerful metal-eating acids to discover if there are any differences in crystal structure. When the chemicals have finished "etching" the metal, a low relief map of the crystalline structure remains.

While yeggs worked on office safe, watchman, bound, managed to sound burglar alarm. He was shot and a bit of bone led to the murderers' capture

Through the miscroscope, the expert can easily tell if the character and shape of the crystals in both specimens are the same. The size of the crystals is determined by whether the metal cooled fast or slow. Their chemical compositions are indicated by the rate at which the acid eats them. And their structure has been affected by the rolling and pounding treatment they received at the mill.

If the crystal structure of two bits of metal are identical, it means all the conditions under which they were produced are identical. In upwards of 15,000 experiments, Dr. Mathews told me, no pieces of steel made at different times have showed the same crystalline structure when tested in this way.

Only a few months ago, an eastern sleuth, who had made a special study of metallurgy, exposed a costly antique as a fake by testing the iron it contained. Instead of being made in the fourteenth century, as the dealer claimed, he found the metal was of a type which could not have been produced except by a process that was not introduced until nearly four centuries later!

Dust often contains specks of metal which are important in tracing crimes. To separate such metal bits from particles of rock and fragments of fibers in dust, Edmond Locard has invented a "graphoscope" with magnetized screens which perform the work automatically.

From specks of metal to stars whirling in space seems a long jump, but the scientific sleuth may have recourse to both in seeking the solution of a baffling crime. For astronomy, strange as it seems, has actually been employed in a number of cases to run down the wanted criminal.

WITNESS how the ace of Austrian scientific detectives, Hans Gross, tripped up the story of a pair of murderers through dramatic testimony by the sun. Late in the fall, the two men had accompanied a wealthy farmer to a distant fair to buy cattle. The next day, their companion was found stabbed to death by a roadside, his money gone. His two companions were held for the crime.

They maintained they had stopped at an inn while the farmer walked on ahead and while they were there, they suggested, someone had waylaid and murdered him. At three-thirty in the afternoon, they said, they left the inn and hurried on to overtake their employer. But, by the time they reached the spot where his body was later found, it was so dark they passed by without seeing it.

Their trial came the following April. Gross consulted two astronomers and learned that on a certain spring day the sun would be at exactly the same height in the sky that it reached on the day of the crime. At three-thirty P. M., on this date, he left the inn where the suspects said they had stopped and walked slowly to the spot where the body had lain by the roadside. When he reached the place, it was still broad daylight! This testimony clinched the case. The verdict was "Guilty."

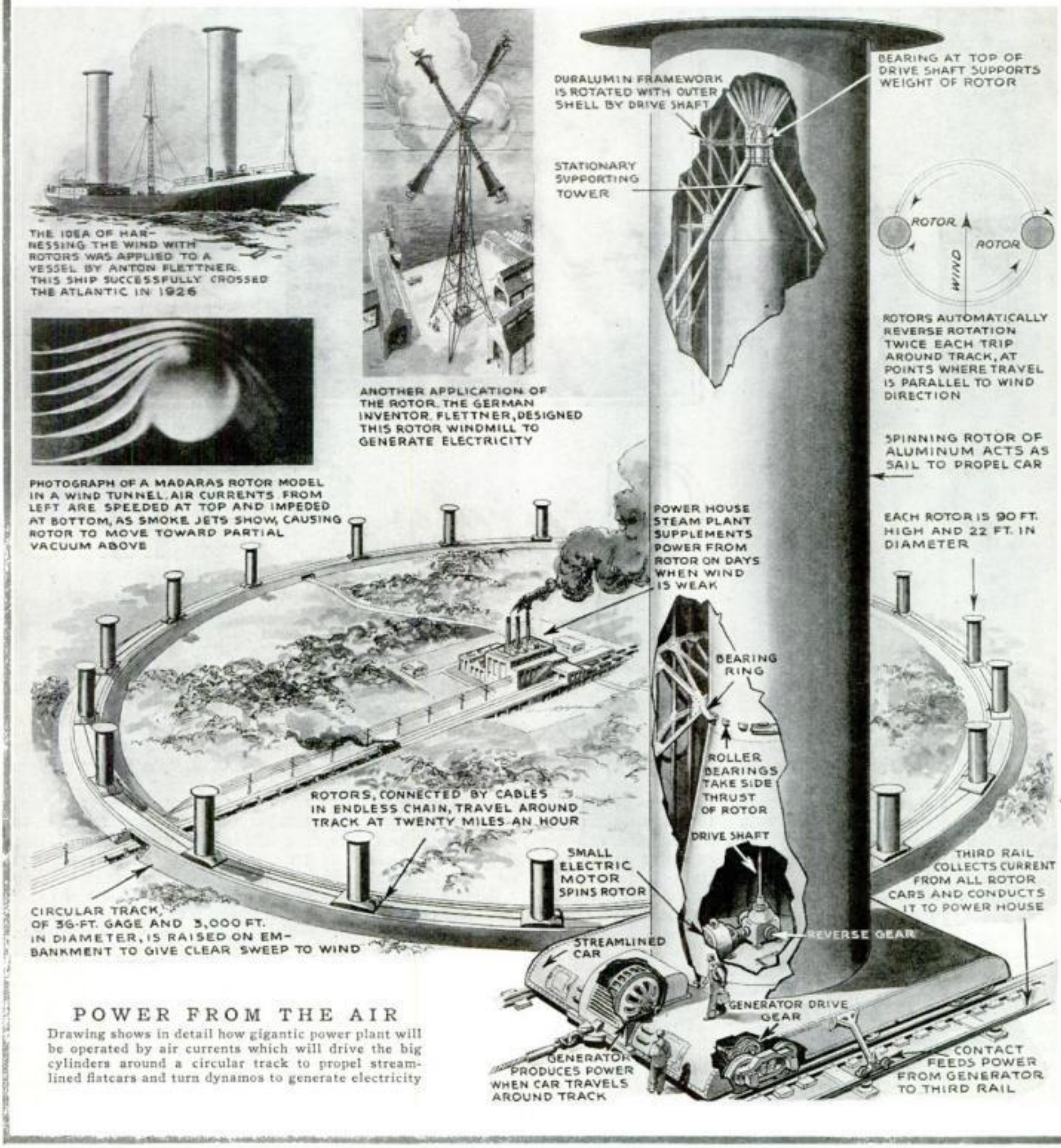
I was told of another sensational case in which meteorological reports of happenings in the sky saved an innocent man from prison. On the same day that a mysterious fire, in Illinois, razed the unoccupied country house of a manufacturer, a former employee, who had been discharged, was seen in the neighborhood. The man was held on a charge of arson. *(Continued on page 120)*

YOU SAVE MONEY
ON THIS GIFT

Give your friend a year's subscription to POPULAR SCIENCE MONTHLY—A special reduced gift subscription price is explained on page seven

Copyrighted material

Big Electric Plant Run by Wind



POWER FROM THE AIR

Drawing shows in detail how gigantic power plant will be operated by air currents which will drive the big cylinders around a circular track to propel streamlined flatcars and turn dynamos to generate electricity

AN AMAZING "merry-go-round" power plant to harness the wind for electrical energy is soon to be built, somewhere in the East, if final tests now under way prove successful. Twenty spinning cylinders will rumble around a track 3,000 feet in diameter in an endless train. They will propel flatcars and turn dynamos geared to the axles.

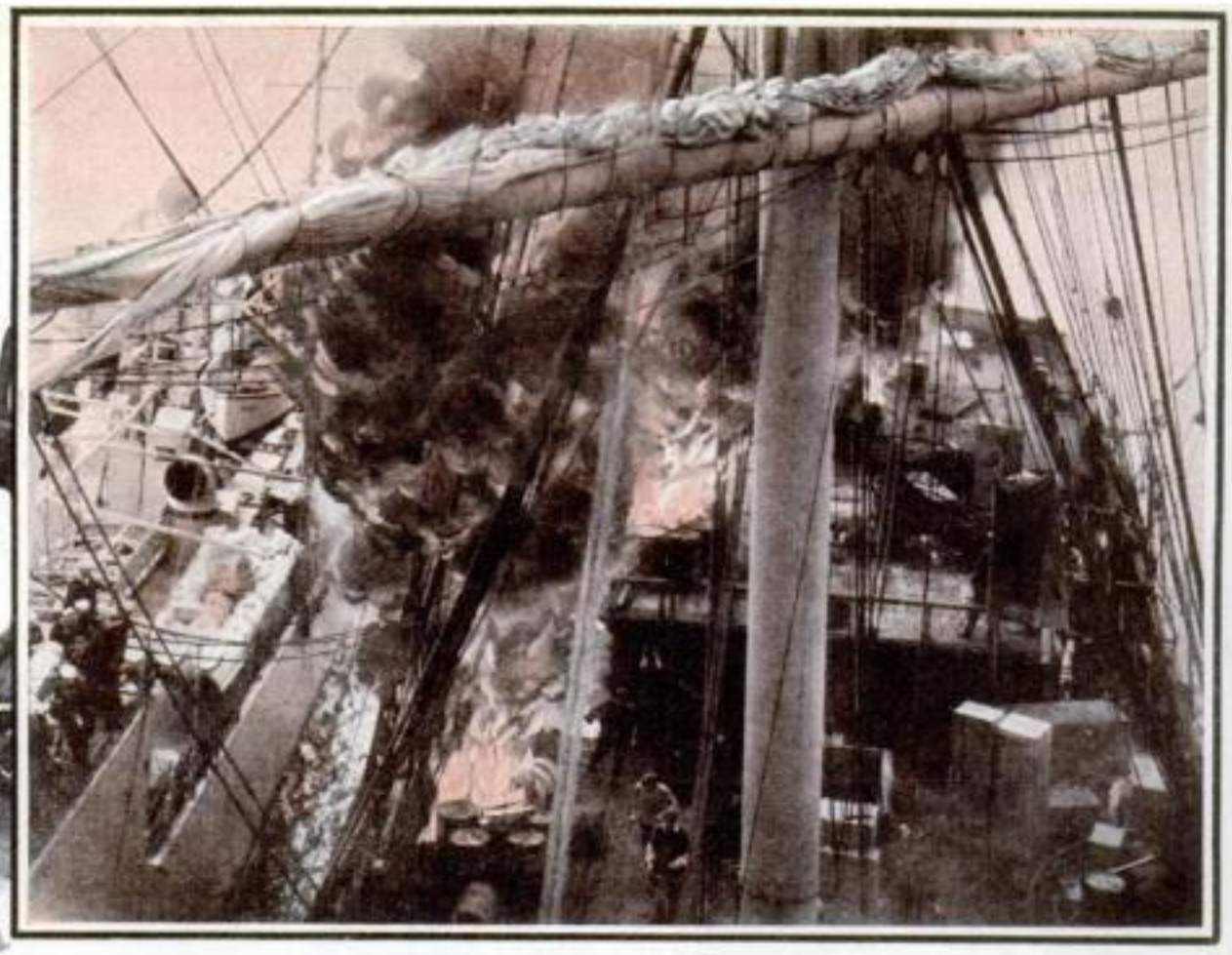
Fantastic as the project sounds, prominent engineers have indorsed it, and six of the most important power companies in the United States have financed the building of the first $100,000 experimental cylinder. Now rising at West Burlington, N. J., this seven-story-high shaft of aluminum recalls the cylinders that propelled Germany's famous "rotor ship" of a few years ago. Like them, it operates on the principle of the so-called "Magnus effect"—that a cylinder spun in the wind tends to move at right angles to the breeze.

The inventor, Julius D. Madaras, a Hungarian engineer living in Detroit, revealed the details of the proposed power station in an interview with POPULAR SCIENCE MONTHLY. Electricity from dynamos on the rotor cars, moving at a fixed speed under automatic control, will be collected by a third rail and conducted to a substation for distribution to the surrounding country. Since the rotors must be spun artificially, a small electric motor keeps each one turning, but it uses only a small proportion of the power generated.

With a twenty-eight-mile wind blowing, Madaras estimates, the completed plant would supply enough electricity for a city of 150,000 inhabitants.

Copyrighted material

Below, Capt. H. N. Burgess, once a master in the China trade, at the wheel of a ship that is to be destroyed for the movies. At right, a windjammer swept by flames started with lycopodium torches and fed by gasoline



Stately SHIPS Wrecked

By
H. H. DUNN

THEY sail into battle and are shattered by gunfire, sunk by torpedoes, sent to the bottom in flames and smoke; their crews are blown to fragments, yet never a man is lost in their destruction, and often they return to play heroic parts in another picture. They are ships in the Suicide Fleet—ships of wood built half a century or more ago and now finding their last ports on thousands of feet of film.

Full-rigged ships, barks, barkentines and even four-masted schooners are being used at the rate of two or three a year. About 100 of them remain, hidden in the ports of the Atlantic or Pacific, waiting their fate before the megaphones of directors riding motorboats fifty miles at sea.

They have appeared in pictures as privateers, ships of war, pirate ships, clippers whose skippers thought nothing of rounding Good Hope or the Horn. With their masts cut down and their hulls altered, they have appeared as Roman triremes manned by dusky slaves or as Greek galleys bearing heroes to meet whatever fate the transplanted gods of Olympus decreed. With their sides built up, they have been the exploring caravels of Columbus and Magellan, or the ships of war of Drake and Frobisher.

Several of them rest beneath half a mile of blue Pacific; others rock idly in various snug harbors, to be used again and again. Directors have found that these hulls of fir and oak cannot be destroyed by ordinary methods. They seem to absorb gunfire; in the most recent of sea pictures, some forty five- and six-inch explosive shells were fired into one of them and 1,200 pounds of dynamite exploded in her hull—yet she still floated, 200 tons of cement blocks in her hold having failed to sink her.

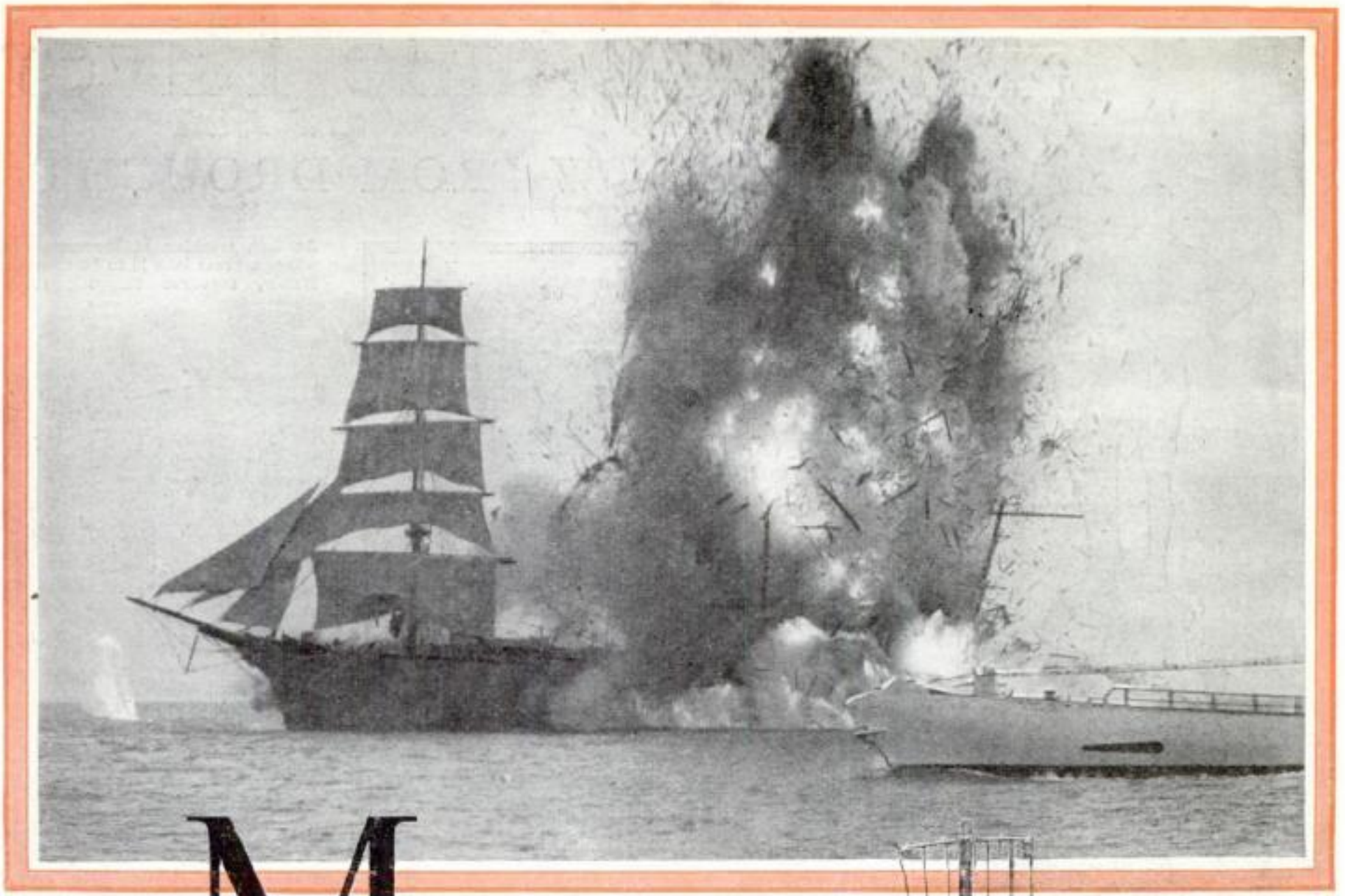
Before these ships, mostly the products of New England forests and yards, sail out as the real heroines of sea pictures, almost every mechanical device known to sailors is fitted in them. To complete the illusion that thrills us on the film, they must be able to sail, with all canvas drawing full and by, in any given direction, without regard to the wind. They must be able to steer themselves without a crew. Their antiquated guns must be capable of responding, for at least one or two broadsides, to their assailants in battle. They must spout men even when their masts are flaming torches, and these men must be able to escape safely from gunfire, explosive blasts, and the flames in which some of the historic vessels end their last voyages.

When a ship is called out from her anchorage, say in the Oakland Estuary, where scores of these ancient windjammers are berthed, she frequently goes into dry dock, if she is to represent a vessel of more than a century ago. There she is virtually rebuilt into whatever design the script may demand. Into her go modern donkey engines, whereby the great spread of canvas may be handled by one third the number of men once required to make or take in sail.

Then crews of old-time sailormen are hired to work the ship in the early sequences of the picture, if she is to be destroyed. If she is to be used in two or three pictures, they continue with her. These men are hard to get. One movie company recently spent three weeks of active search in the ports of the Pacific coast before it could enroll thirty-two real deep-sea sailors to man two sixty-year-old barkentines for a picture. Many of the old masters of these ships have migrated to California to spend their concluding years, and they come out of their retirement to direct the realistic maneuvering of the vessels over whose decks they once ruled supreme.

THEN actors, garbed as Greek, Roman, Phoenician, early British, Revolutionary American, or other sailors, are put on board to fill in the crew. The male star of the cast becomes the boy bo's'n who is to save the ship—or the fighting captain, as the case may be. Usually, in the first sequences of the ships that are to be destroyed, and throughout the picture in those that are to survive, the below-decks is converted into a hotel for the two to four weeks that the company

Copyrighted material



for Movies

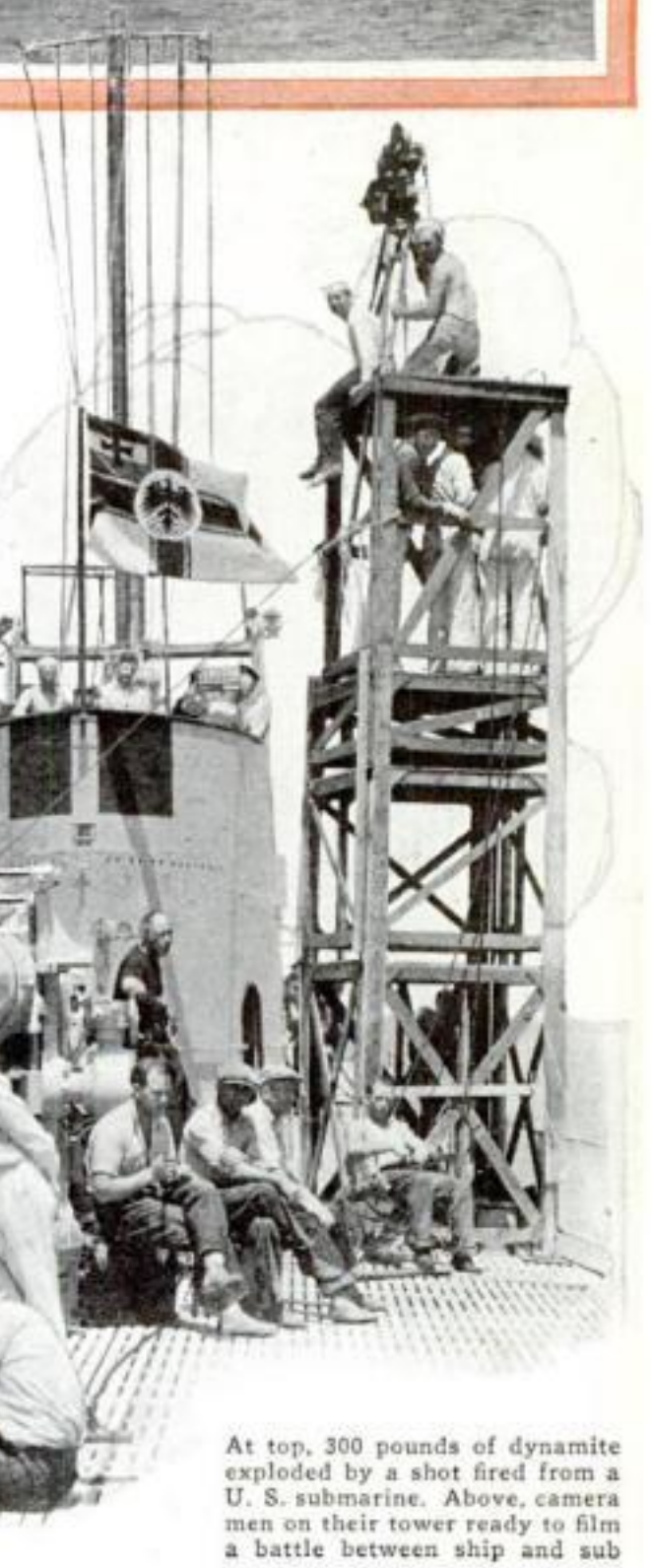
will be on sea location, possibly fifty miles off the southern California coast.

In a recent picture, one barkentine was converted into a hotel where 150 men boarded and slept for the entire three weeks. Then, the hotel was moved out bodily, its four chefs and score of room servants returned to Hollywood, and the vessel destroyed by gunfire and explosives.

BUT the greatest mechanical ingenuity is demanded of the motion picture technicians when the ship is to be destroyed to make the climax of a sea picture. In her hold, along the built-up keel four feet thick, are laid 200 to 400 tons of rough blocks of cement, cast for the purpose in such shape that they will not shift, but will hold her on an even keel until released through holes shot in her.

Distributed above this cement are 1,000 to 1,500 pounds of dynamite, in "caches" of 100 pounds or more. Mixed with this dynamite are 200 to 300 pounds of Cordeaux tubes, packed in lead, taking the place of the fulminating caps commonly used to explode dynamite. Outside her hull, below the water line, are hung other and smaller packages of dynamite, waterproofed in oilskins. These explosives are connected, through the Cordeaux tubes, with a series of wires leading to a large waterproofed cable that runs overside. This cable, 2,000 feet or more in length, leads, under water, to a switchboard on a barge or motorboat, current being supplied by a Diesel or gasoline generator set on board the craft.

A dynamite technician sits at this switchboard, which is made up with a button for each package of explosive, the buttons being set in the outline of the vessel's hull so that the operator at will may explode any one, or any number, of the caches of dynamite. His job is to set off the charges, synchronizing each explosion with the sound and sight of a shot fired by an attacking vessel. *(Continued on page 116)*



At top, 300 pounds of dynamite exploded by a shot fired from a U. S. submarine. Above, camera men on their tower ready to film a battle between ship and sub

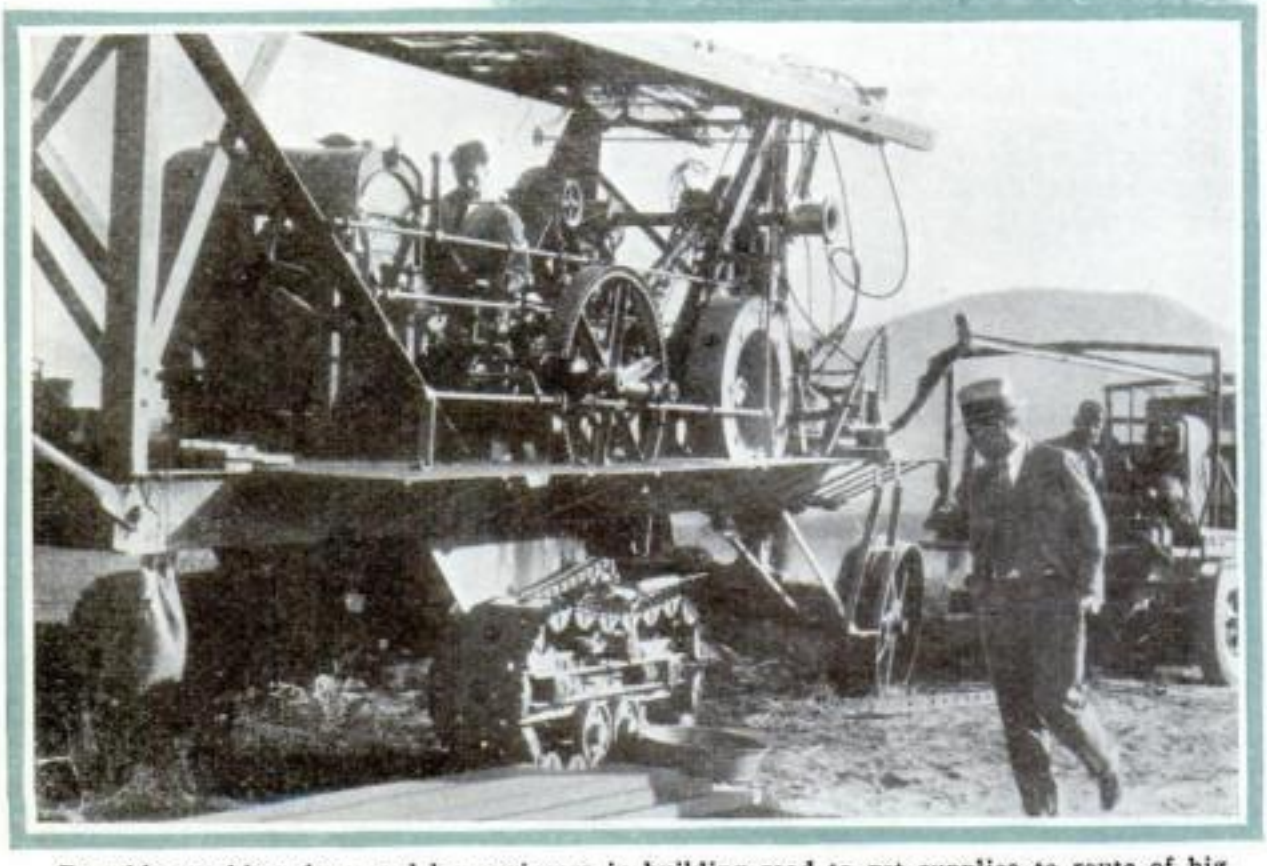
Copyrighted material

Dig 266-mile River

TO SAVE CITY FROM DROUGHT

At left, working at Hoover Dam where a great lake is to be created. Below, surveyor mapping route

Surveyor near the proposed route of the 265-mile river that is to carry water to Los Angeles



Portable machine shop used by engineers in building road to get supplies to route of big aqueduct that will make deserts bloom and provide farm homes for 5,000,000 persons

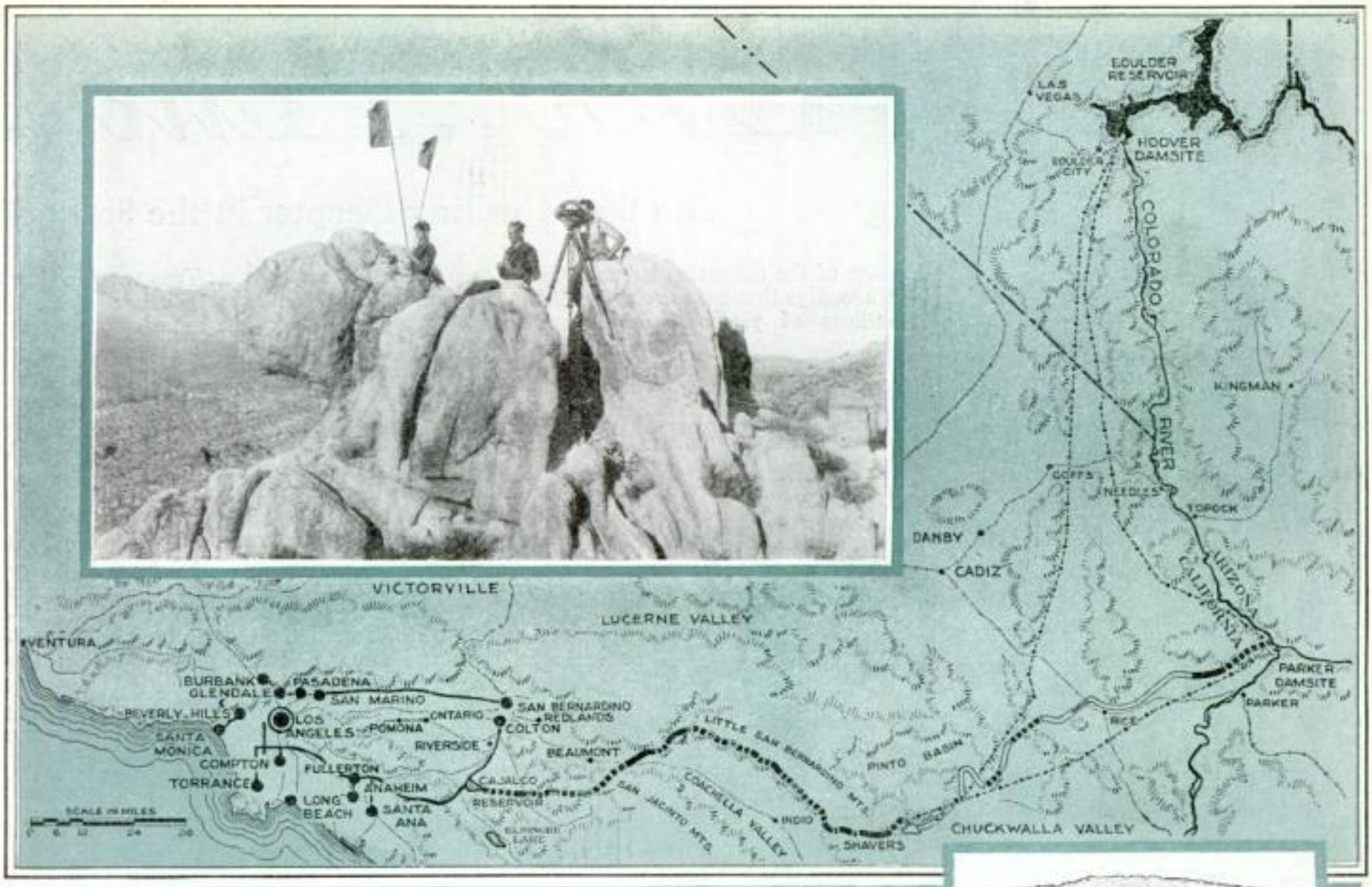
EIGHTY engineers, scaling precipitous peaks and tramping over burning sands, have just completed the survey for the biggest and longest aqueduct in the world. From a hundred possible courses, they have picked a route for the man-made river that will bring Colorado River water to Los Angeles and southern California, 266 miles away.

Ten thousand men will be needed to build the monster Metropolitan Aqueduct. When the six-to-eight-year task is finished, Los Angeles' population will be saved from danger of water famine (*P. S. M.*, Oct. '31, p. 42). But that is not all. Turned into the parched but fertile deserts of southern California, the $220,000,000 river will change them into blooming gardens and orchards. Between Los Angeles and the Mexican border, 5,000,000 more people will be able to find homes.

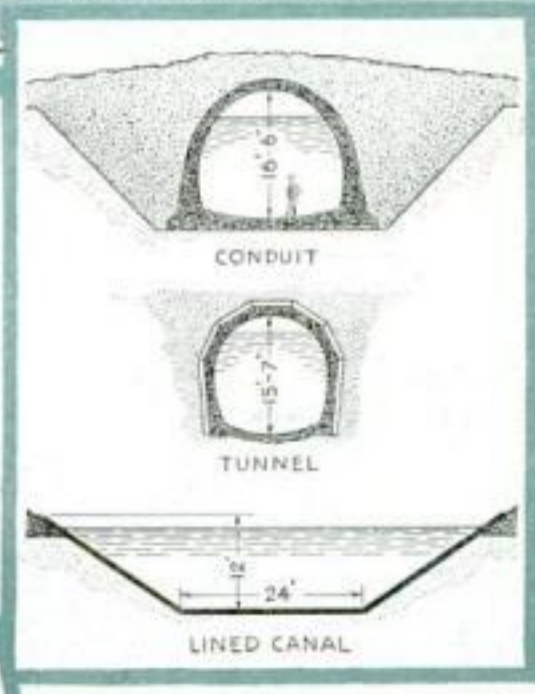
To plan the artificial stream that is to work this transformation, the survey engineers spent eight years going over more than 60,000 square miles of arid wasteland—an area equal to the combined size of Iowa, Delaware, and Rhode Island. Each survey party of four traveled in a light auto and camped in the desert.

The route that has been selected and staked out on the ground taps the Colorado River near Parker, Ariz., about 125 miles downstream from Hoover Dam. Electric pumps will lift the torrent of water a quarter of a mile high at the start, and it will course through mountain ranges in tunnels large enough for a locomotive. Forty tunnels in all will be bored, one of them thirteen miles long. When it reaches the plains, the aqueduct will emerge from the ground and become an open, concrete-lined canal deep enough to float a ship drawing twenty feet of water. At its terminus, the aqueduct will **pour a billion gallons daily into a huge reservoir adjacent to Los Angeles.**

Copyrighted material

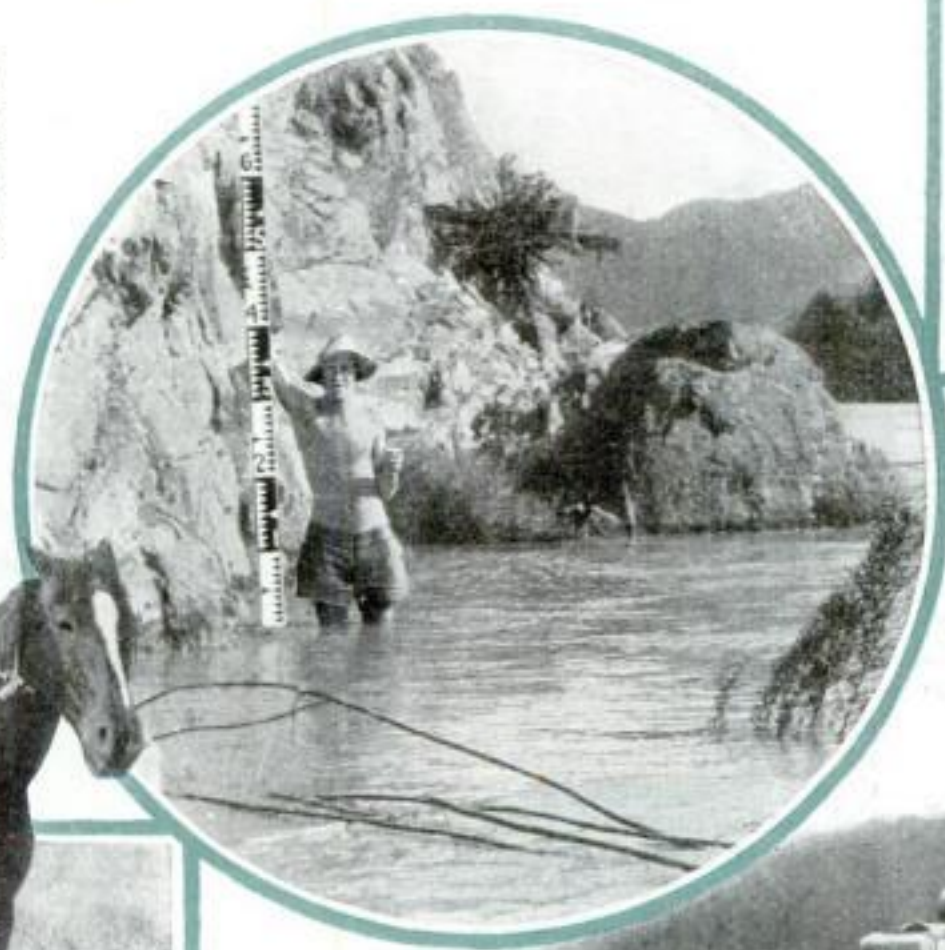


Inset, above, a group of the giant crags carved into strange shapes by the centuries of wind-blown sand that has beaten against them. The broken line on the map shows the proposed route of the aqueduct from the Colorado River to Los Angeles. Hoover Dam location also shown in upper right-hand corner



Three cross sections of the big aqueduct, showing the dimensions in the conduit, the tunneled portions, and the open canal section

In circle, an aqueduct surveyor holding stadia while he is standing in the Colorado River. Below, where cars could not go the surveyors used horses or burros as they mapped the route of the drought defying waterway



Machinery for building Hoover Dam was floated down the Colorado. When completed this dam will form a lake 110 miles long and insure water for the Los Angeles aqueduct

Copyrighted material

Why *Love*.. *Hate*..

Another Thrilling Chapter in the Story of

DISGUST

TERROR

ECSTASY

SORROW

DELIGHT

In the pictures on this page familiar emotional reactions are registered on the face. Note how each, from disgust to delight, is suggested by a recognizable facial expression

Courtesy, Metro-Goldwyn-Mayer

THAT complex creature, Modern Man, with his loves, hates, and fears, developed from a tiny speck of living jelly about a billion years ago. It was at this point that Dr. William K. Gregory, famous scientist of the American Museum of Natural History, began the fascinating story unfolded in this series. He pictured our slow pilgrimage through eons of time. Then Dr. Herbert Ruckes, distinguished member of the biological faculty of the College of the City of New York, explained how man hands on his characteristics to his offspring. Last month, Dr. Ruckes described the work done by the glands of internal secretion. In this talk, Dr. A. T. Poffenberger, head of the Department of Psychology, Columbia University, New York, tells Michel Mok, staff writer, how our emotions mold our actions and behavior.

• •

MR. MOK: Dr. Poffenberger, I have come to you for the story of our emotions. Will you please tell me why people love, hate, fear, and get angry? In fact, what is an emotion?

DR. POFFENBERGER: Let me begin by trying to answer the question that interests the average person most. People love because, almost a billion years ago, some tiny, primitive creatures got tired of tearing themselves in two—which, as you know, was the original method of reproduction—and adopted the sex method of perpetuating their kind. Love, in the sense of the attraction between the sexes, is a vestige that has survived millions and millions of years of development and change.

MR. MOK: I thought a vestige was some part or function of a person or animal that had lost its usefulness; such as, for instance, the appendix. I find it hard to understand that this organ and the emotion of love have anything in common.

DR. POFFENBERGER: An organ or, for that matter, an emotional response need not have lost all of its usefulness to be a vestige. It becomes vestigial as soon as it begins to lose its utility.

MR. MOK: You mean, then, that love has lost some of its usefulness?

DR. POFFENBERGER: Much of it. There is no doubt that the sex impulse was necessary to the mysterious process of change we call evolution. It also was essential to the preservation of each individual species. It is almost equally certain that, in the case of man, it is far less needed today. In primitive times, a great number of people had to be born in order that a comparatively small number might survive. Now so many elaborate means are used to preserve them for a long life, with a consequent decrease of the death rate, that not as many individuals need to be brought into the world.

MR. MOK: Just the same, the old tender passion still seems to have a powerful hold on most of us.

DR. POFFENBERGER: True enough. However, as it continues to decrease in usefulness, we may lose some of our capacity to respond to this emotion, just as organs begin to disappear when there is no longer any real use for them. But that is not likely to happen for another million years, so you need not worry about it.

MR. MOK: I wasn't exactly worried. Is love the only emotion that has become vestigial?

DR. POFFENBERGER: No; in the light of this interpretation, we appear to possess a whole set of emotional responses that have lost part or all of their usefulness. Some have become positively harmful. But we are running ahead of our story, and I will return to this question later. First, I want to tell you something of our basic, or primary, emotions.

MR. MOK: What are they?

DR. POFFENBERGER: Dr. John B. Watson, the distinguished psychologist, while director of the psychological laboratory in Johns Hopkins University, made a series of notable experiments with a number of infants only a few hours old. These tests showed that all normal children, immediately after birth, experience only three emotions—fear, anger, and love.

MR. MOK: How can a

Copyrighted material

..*Fear* Rule Our Lives

Life—*World's Greatest Mystery*

young baby experience the love emotion?

DR. POFFENBERGER: By love, in this case, is meant the pleasurable response to stroking of the skin. In other words, all babies, almost from the hour they are born, like to be petted. This, according to Dr. Watson, is *the basis of all love.* Now, the emotional life of every adult is based upon these three fundamental, primitive emotions.

MR. MOK: How did Dr. Watson find out that newborn babies feel these three emotions?

DR. POFFENBERGER: He aroused them by certain definite means, and then closely watched the appearance and behavior of the infants. He and his successors even made photographs and motion pictures of them. The experiments revealed the interesting fact that there are two ways of stimulating fear in babies, and also two to stimulate anger.

MR. MOK: What are the two things that babies are afraid of?

DR. POFFENBERGER: They fear an abrupt loud noise and the sudden removal of support; in other words, being dropped.

MR. MOK: Why is that so remarkable? I should think that was a foregone conclusion. We are all afraid of these things.

DR. POFFENBERGER: Yes, but the remarkable part is that babies are *not afraid of anything else.*

MR. MOK: What are the two things that make a baby angry?

DR. POFFENBERGER: Restraining its movements, such as pinning its arms to its sides; and hunger. Nothing else will make an infant cross. As for the love response, the only way Watson found to arouse it was by gentle stroking of the skin, particularly in the more sensitive zones of the body.

MR. MOK: How did the babies in the experiments show that they liked being petted?

DR. POFFENBERGER: By an unmistakable expression of pleasure; you might call it a near-smile. However, these tests were not quite so successful as those in which the fear and anger reactions were established. Not much could be done in the "love" line because of the firmly rooted and wholly justifiable prejudice against fondling babies.

MR. MOK: You said that the emotional life of every adult is built upon the three basic emotions of fear, anger, and love. How does that happen?

DR. POFFENBERGER: By the conditioning process.

MR. MOK: What do you mean by that?

DR. POFFENBERGER: The process of learning, or associating new experiences with the original ones. I can best illustrate this with a simple case described by Dr. Watson. The older psychologists, among them the famous William James, believed that children were born with many fears; that they were afraid of the dark, of furry animals, and a number of other things. It was Watson's contention that these fears were acquired in early infancy. To prove this, he took a baby a few months old and gave it a live rabbit to play with. The child was not afraid at all. Then he deliberately taught it to fear the rabbit.

MR. MOK: How?

DR. POFFENBERGER: One day, while the baby was playing with the rabbit, Watson struck a metal bar close to the child's ear. Here was a sudden loud noise, and fear was aroused in the infant. What happened? In the baby's mind, the noise was tied up with the presence of the rabbit, and after that, the child feared the animal. This is the so-called *conditioned reflex;* the process by which a given response gets attached to a new stimulus because this new stimulus appeared together with the one that originally called forth the response. In this way, a formidable collection of fears is built up in the childhood of most people.

Courtesy, Paramount and Metro-Goldwyn-Mayer

Group of pictures above shows how human face is capable of showing any emotion from love to murderous hatred, each one having a typical physical reaction

MR. MOK: Is fear of the dark acquired through the original fear of a sudden loud noise?

DR. POFFENBERGER: It is. A small child may learn to fear the dark on a night when it is awakened by a clap of thunder or by the rattling of the windows or shades in the nursery. To the baby, that which accompanies the noise, in this case darkness, becomes responsible for the noise. It has been suggested that the fear of snakes, mice, spiders, and other creatures is acquired in the same way. As you know, many people never get over that.

MR. MOK: But surely snakes, mice, and spiders make no sudden loud noises?

DR. POFFENBERGER: No, but a baby's mother often does at the sight of one. The mother lets out a shriek; the baby is frightened by the noise, sees the snake, the mouse, or the spider, and associates it with the startling sound. The importance of Dr. Watson's findings lies in the

Copyrighted material

fact that, before he made his studies, none of this was known. James and his disciples assumed that the emotional equipment of a child of, say, five or seven years, was its natural endowment; that it had possessed, ever since it was born, the emotions which it showed at that age.

MR. MOK: What surprises me is that a newborn infant shows even these few emotional responses. I should have imagined that, emotionally, a baby a few hours old was a perfect blank. How do you account, for instance, for the fact that it is annoyed by a sudden loud noise?

DR. POFFENBERGER: I believe the reason is that, in the prenatal state, there is a complete absence of strong stimulation. In other words, a baby, before it is born, probably is never annoyed, as you put it, by anything, nor particularly pleased. So far as we can tell, it seems to be in a state of unruffled peace and security.

MR. MOK: Can an infant be cured of acquired fears?

DR. POFFENBERGER: Yes, but it is a difficult job. A single experience may establish one of these fears, but it takes dozens of trials to rid a child of one. Once the mechanism by which the fears are acquired is understood, they can be removed by practically the same process. We call that *reconditioning* or *deconditioning* the child. Take, for example, the baby that is afraid of a furry rabbit. Suppose that this child is fond of a particular breakfast food; say oatmeal. The method is to bring the fearsome object into the baby's vicinity whenever it is eating this cereal. But it has to be done gradually. If it is done too quickly, it may have the opposite effect; the baby may get afraid of its food, and you would have two fears on your hands instead of one. So, the first time, the rabbit is kept at a considerable distance from the baby's chair, but each time after that, it is brought a little closer. By and by, the infant begins to hook up the rabbit with the pleasant sensation of eating oatmeal, and the fear is overcome.

MR. MOK: Do grown people acquire their abnormal fears in the same manner?

DR. POFFENBERGER: Yes, essentially the same mechanism works in adults, and is responsible for some nervous disabilities. This came out clearly in cases of shellshock during the World War. The men were treated by keeping them absolutely quiet at a hospital. This was needed because even the dropping of a book would cause them to react violently. It often happened that a patient who was getting along pretty well suddenly would suffer a relapse, and again show all of his original symptoms —sweating, tremors, temporary paralysis. At first, the reason for such setbacks was a mystery. Then it was discovered that a man in uniform had walked through the ward. The mere sight of the soldier was sufficient to bring on a renewed attack, because the patient's original experience has been connected with men in uniform. In other words, the patient's extreme fear of a harmless doughboy was a conditioned reflex. Do you understand that the mechanism which caused him to fear the man in uniform, who was in no way responsible for his trouble, was essentially the same as that which caused the baby in Watson's experiment to fear the rabbit, though it was a noise and not the rabbit that had originally frightened it?

Head measurements are made with this apparatus, a plastometer, in psychological studies in Germany

MR. MOK: I understand. You say that men suffering from shellshock showed such symptoms as tremors and temporary paralysis. Of course, those were abnormal cases. Do normal emotions have bodily effects?

DR. POFFENBERGER: I am glad you asked me that question, for it gives me an opportunity to try to explain what an emotion really is. Literally, the word means a shaking up, a stirring up. An emotion, then, is an agitation, a disturbance, a tumultuous movement. Don't confuse this with feeling. The characteristic of an emotion is the experience of being stirred up. William James, the great American psychologist, who died in 1910, said that an emotion was *the conscious experience of changes taking place in the body*. Feeling, on the other hand, lacks that reverberation. Feeling probably is a mild form of emotion. The presence or absence of reverberation is what makes the difference.

MR. MOK: I don't quite understand what you mean by reverberation. What are the bodily changes that take place in the case of emotion?

DR. POFFENBERGER: Have you never blushed? Has your heart never beaten faster at sight of your sweetheart? Have you never had a "sinking" feeling at the pit of the stomach while awaiting the results of an examination? Have you never been in a "cold sweat," or "hot under the collar"? These phenomena, which are so common that their designations have become part of everyday speech, are due to actual changes in the rate of the heartbeat and of breathing; in the distribution of the blood; in the muscular tension in various parts of the body. The experience of these and other physical reactions, according to James's idea, constitutes emotion. In other words, when you are afraid, you do not feel something intangible in your mind; you feel concrete changes taking place in your body.

MR. MOK: I should have thought that the exact opposite was true; that the physical reactions were the results, the effects, of the emotions. What is your idea?

DR. POFFENBERGER: Personally, I am convinced that James was right. But convictions don't prove anything. The truth of this theory, as yet, has not been established experimentally to the complete satisfaction of scientists. Dr. Walter B. Cannon, professor of physiology in Harvard Medical School, who is noted for his extensive studies in this field, and who has made careful measurements of physical changes during emotional stress, has been unable to find differences in physical reactions corresponding to different emotions. He has, for instance, timed the pulse, breathing, and heartbeat, measured the blood pressure, and made minute observations of other functions of a person in anger, among them the digestive movements of the stomach. Taking similar measurements of the same person in fear, he found that the results were about the same.

Prof. W. M. Marston, of Columbia University, made scientific tests with a blonde and a brunette to determine emotional reactions. Results indicated brunettes are higher keyed

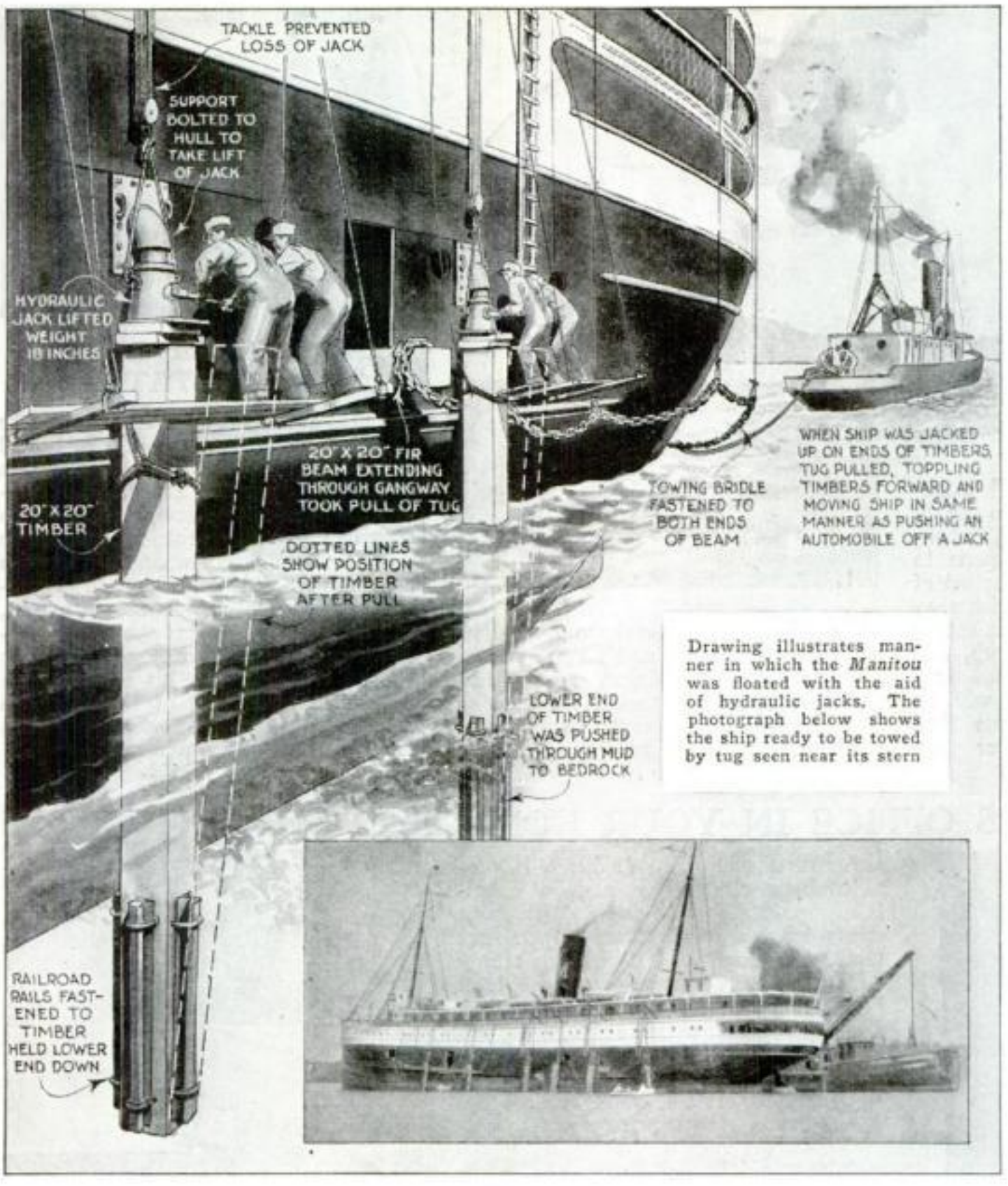
MR. MOK: Isn't it possible that the physical reactions of fear and anger are the same?

DR. POFFENBERGER: Not if James's theory is true. If emotion is the

(Continued on page 119)

Copyrighted material

Mighty Hydraulic Jacks Used to Float Stranded Passenger Liner



Drawing illustrates manner in which the *Manitou* was floated with the aid of hydraulic jacks. The photograph below shows the ship ready to be towed by tug seen near its stern

WHEN the passenger steamer *Manitou* ran fast aground in the St. Marys River between Lake Superior and Lake Huron, and tugs snapped their towlines attempting to pull her loose, a remarkable engineering feat was performed to float the stranded vessel.

Salvagers drove six huge fir timbers, like piles, on each side of the ship. Above each timber they bolted a "hutchix plate," a steel bearing surface with a noselike projection, directly to the vessel's hull. Then husky hydraulic jacks were inserted between timbers and plates. Meanwhile, to take the terrific strain of a towing hawser, a massive wooden beam was installed athwart the ship. An anchor chain fastened to the beam made a towing hitch.

Then two men took their places at each of the hydraulic jacks. At a signal, all began to pump the handles in unison. Slowly the vessel rose from its muddy cradle to the maximum safety lift of eighteen inches. Then the powerful salvage tug *Favorite*, capable of putting a seventy-five-ton strain on her two-and-a-half-inch cable, coupled up and steamed ahead. Like an automobile toppling from its jack, the liner lurched forward and settled four feet nearer deep water.

Next the timbers were moved to the new position and the jacks reset. This time a pull gained six feet. The next lunge won twelve feet more. Then, without the jacks' aid, the tug, its 1,800-horsepower engine churning the propellers at full speed ahead, was able to pull the *Manitou* free.

PAY ROLL SATCHEL SHOOTS BLINDING TEAR GAS AT BANDITS

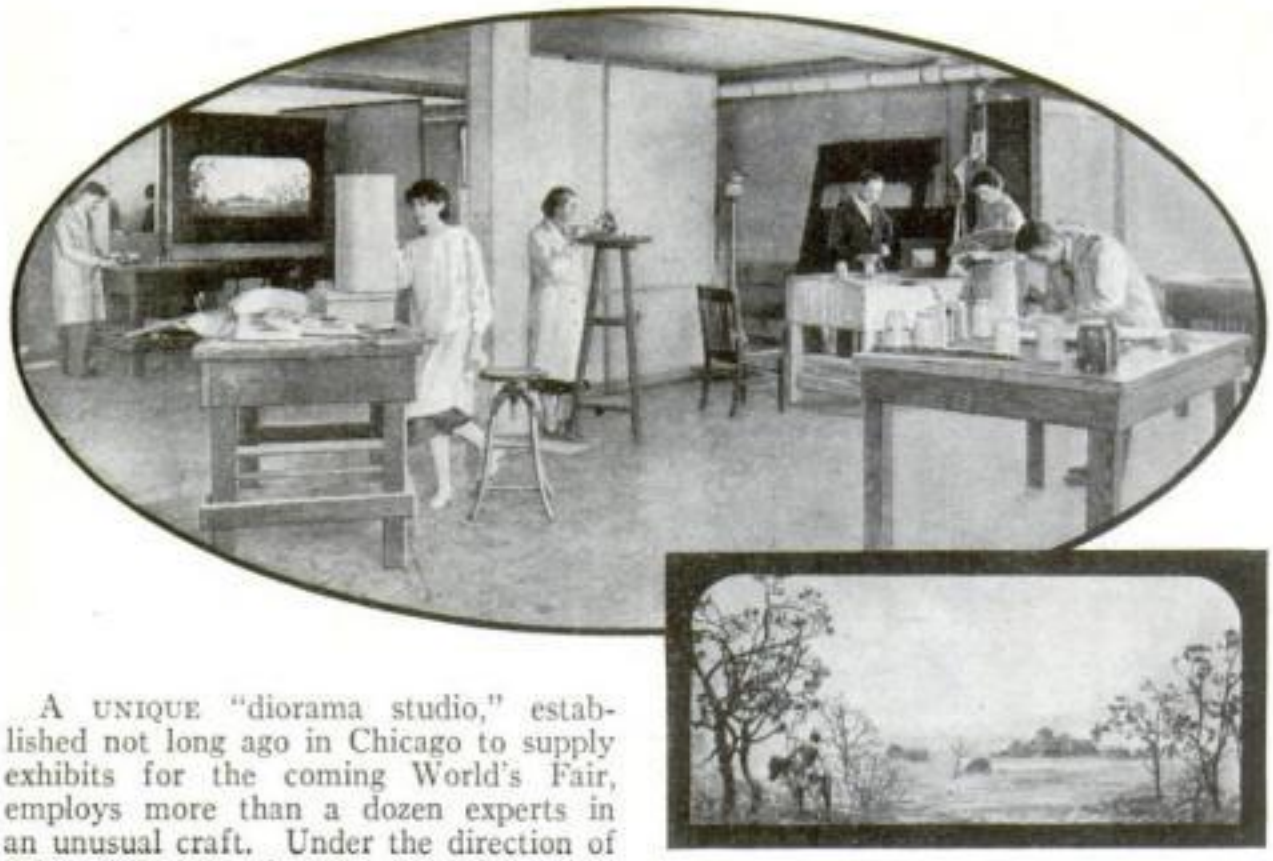
TEAR gas thwarts the bandit in an ingenious new pay roll satchel, which automatically shoots off a stream the moment the bag is taken from a messenger's hand. When the messenger is carrying the bag through the streets, a ring attached to a chain is firmly grasped in his finger or fastened to his wrist. This is attached to a firing pin whose withdrawal operates the tear gas trigger. Should a bandit approach and at the point of a gun demand the bag, the messenger makes no resistance. He simply drops the bag or allows the thug to snatch it, retaining the finger loop and chain. Instantly a cloud of tear gas spurts from a nozzle at the side of the bag, and continues to fill the air for three or four minutes. Anyone within a hundred feet is temporarily blinded with tears, and police can easily capture the robbers. No permanent ill effects are caused by the gas, however, and its effect lasts only half an hour. The satchel's tear gas reservoir is refillable.

At right, pay roll bag that shoots tear gas. Note chain attached to man's finger. Above, inspecting apparatus

Drawing shows what happens when bandits take pay roll bag from messenger and tear gas is shot out

Copyrighted material

HISTORICAL SCENES CREATED IN STUDIO



A UNIQUE "diorama studio," established not long ago in Chicago to supply exhibits for the coming World's Fair, employs more than a dozen experts in an unusual craft. Under the direction of Edward J. Ashenden, London artist, they fashion lifelike scenes or dioramas having apparent width, height, and depth, and with realistic effects of sunshine and shadow. Scenes of this kind will be used to explain historical events that could be dramatized in no other way.

Some of the dioramas have a window seven feet in width, and all are appropriately modeled, colored, and illuminated from within. The Colonial Exposition in Paris also ordered five dioramas, and a Chicago hotel has several.

STEAMFITTER CARVES HIS OWN STATUES

A STEAMFITTER by profession, George W. Arbuckle, of Vineland, N. J., turned sculptor to decorate his home. Although he has never studied art, he has completed, in his spare time, a remarkable series of pieces in marble. These include fountains, life-sized lions, and a thirty-ton copy of the Statue of Liberty. The amateur sculptor takes no measurements, depending entirely on his eye for proportion. He also upsets the accepted rules of art by working on his statues from the bottom up instead of from the top down. He is shown above putting the finishing touches to a marble lion.

"BOOKCASE" PUTS OFFICE IN YOUR HOME

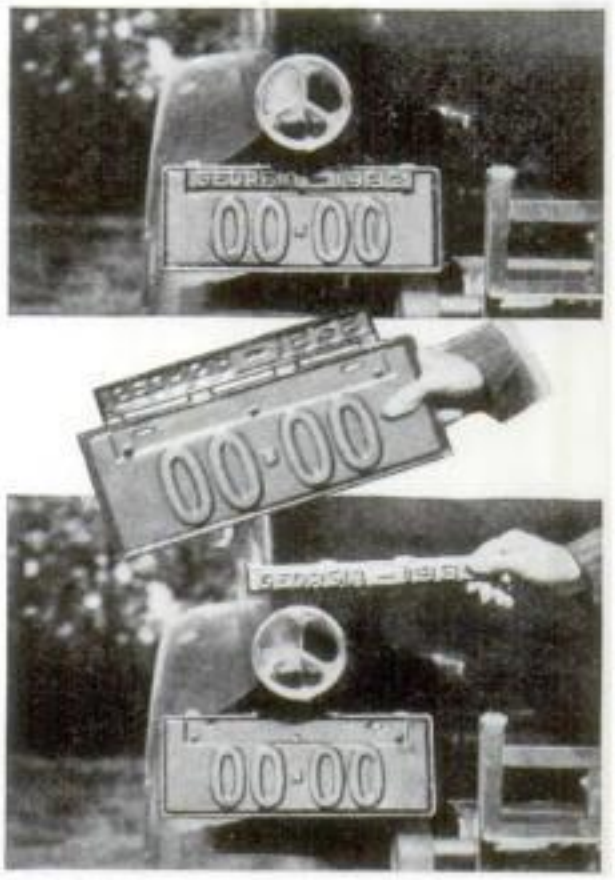
This bookcase is really a complete office for the home, containing a set of drawers and typewriter

A MINIATURE office at home is provided by a camouflaged piece of furniture resembling a bookcase. Its front opens downward to become a typewriter table, supported by a sliding but sturdy base. A disappearing rack at eye level holds memoranda or pages to be copied. Drawers at the side, for supplies and filing, are hidden by a door.

NEW FIRE PUMP RUN BY AUTO'S ENGINE

A NEW aid in fighting forest fires, a pump that can be attached to the front of any automobile, was tried out recently in Vienna, Austria. Equipped with one of these devices, the car can speed across country to answer an alarm. At the scene of the fire an intake hose is dropped into the nearest lake or stream, and a nozzle fitted to another hose sprays water on the blaze. The pump takes its power from the crank shaft of the car's engine.

Fire-fighting pump attaches to auto and is driven by car's engine. Hose is dropped in lake or stream



THIEVES CAN'T STEAL THIS LICENSE PLATE

No THIEF can steal the novel auto license plate invented by a Georgia man, for it breaks in two when an attempt is made to remove it. The plate is standard except that the name of the state and the year are imprinted on a projecting tab, connected to the body of the plate only by fragile necks of specially-treated metal. After the plate is attached with the usual bolts, this tab is then bent down carefully over the bolt heads. Lifting it to get at the bolts breaks it off, making the license plate useless, and preventing the operation of cars with stolen plates or ones from scrapped cars.

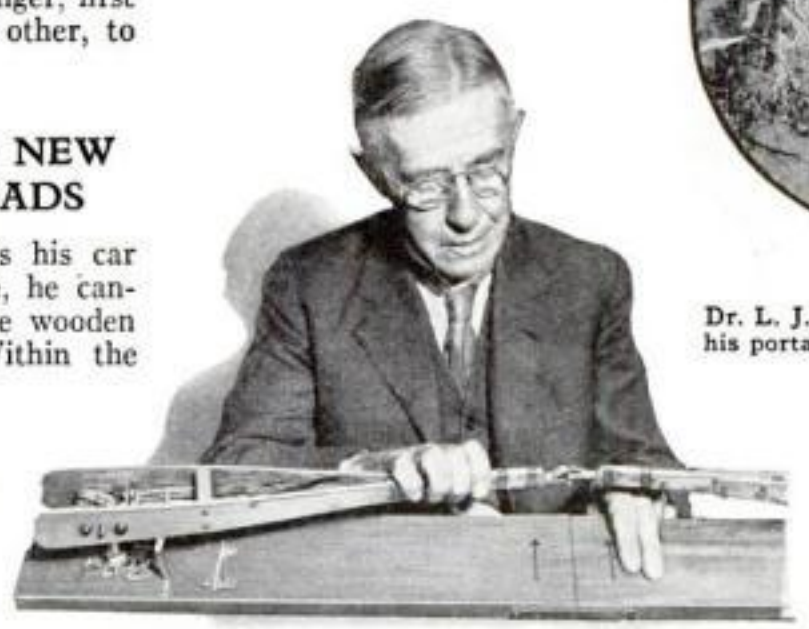
Copyrighted material

SHAVING LOTION BOTTLE ALSO SHARPENS RAZOR

A DOUBLE aid to sensitive skins is a bottle containing an after-shaving lotion recently placed on the market. One side of the bottle is curved and etched with acid to provide a honing surface for razor blades. The blade is moved several times from side to side with the forefinger, first with one side up and then the other, to give it a keener edge.

CARS CAN'T CRASH NEW GATE FOR RAILROADS

IF A reckless motorist drives his car into a new type of safety gate, he cannot go through even though the wooden frame is shattered to bits. Within the frame is a husky steel cable that will stop the car with its front wheels in the air, if necessary, to keep it from the path of an approaching train. According to J. Harsen, New York mechanical engineer and inventor of the gate, the impact is so gently taken up by springs that no serious damage is done either to the car or its occupants. Cables threading the center of each gate terminate in a hook-and-eye joint that makes its connection when the gates go down. The gateman then presses a button that operates an electric solenoid and slides a locking pin into place.



USE X-RAY TO GET BIGGER CORN CROP

TRUNDLING an X-ray machine on wheels up and down the rows of an experimental garden, Dr. L. J. Stadler, of the Missouri College of Agriculture, is seeking to produce new species of farm crops by subjecting his plants to treatment by the invisible rays. Strange alterations take place in corn and other growing plants when they are bombarded by X-rays, laboratory tests have previously shown. Dr. Stadler expects improved varieties to result from this practical experiment. His portable apparatus receives electric current by a long cable.

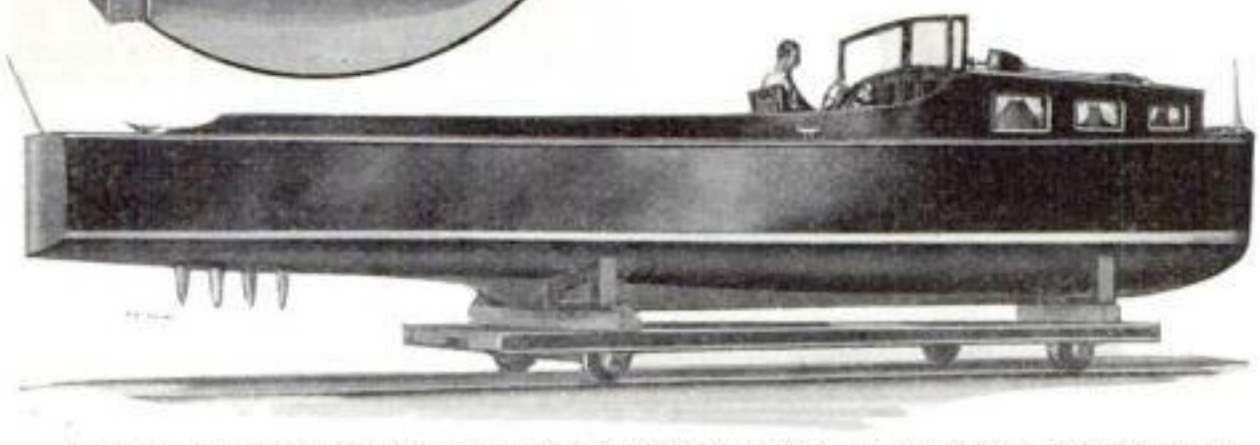
Dr. L. J. Stadler, of Missouri College of Agriculture, and his portable X-ray machine used to get better farm crops

TOWS THREE GLIDERS

FOR the first time in aviation history, an airplane recently towed three gliders in vee formation. The stunt was carried out at LeRoy, N. Y., in a test to show the practicability of aerial trains composed of airplanes and gliders.

MOTORBOAT PROPELLER IS ALSO RUDDER

PROPELLER and rudder are combined in a novel motorboat drive developed by a German firm. It enables a boat to turn completely around in its own length, and gives it remarkable maneuverability in cramped places. Outwardly resembling a washing machine, the propeller unit is installed in the boat so that only four oar-shaped paddles project below the hull. These revolve on a main rotor, and also spin on their own individual vertical shafts. At the control of the pilot, the vanes may be set so that they cast a jet of water straight astern for forward motion, to one side for turning, or ahead for a stop.



In circle, new propeller unit, resembling a washing machine, which enables a motorboat to turn in its own length. Above, a boat equipped with the combination rudder and propeller

STICK ON CHAIN STOPS DOGS THAT CHASE CARS

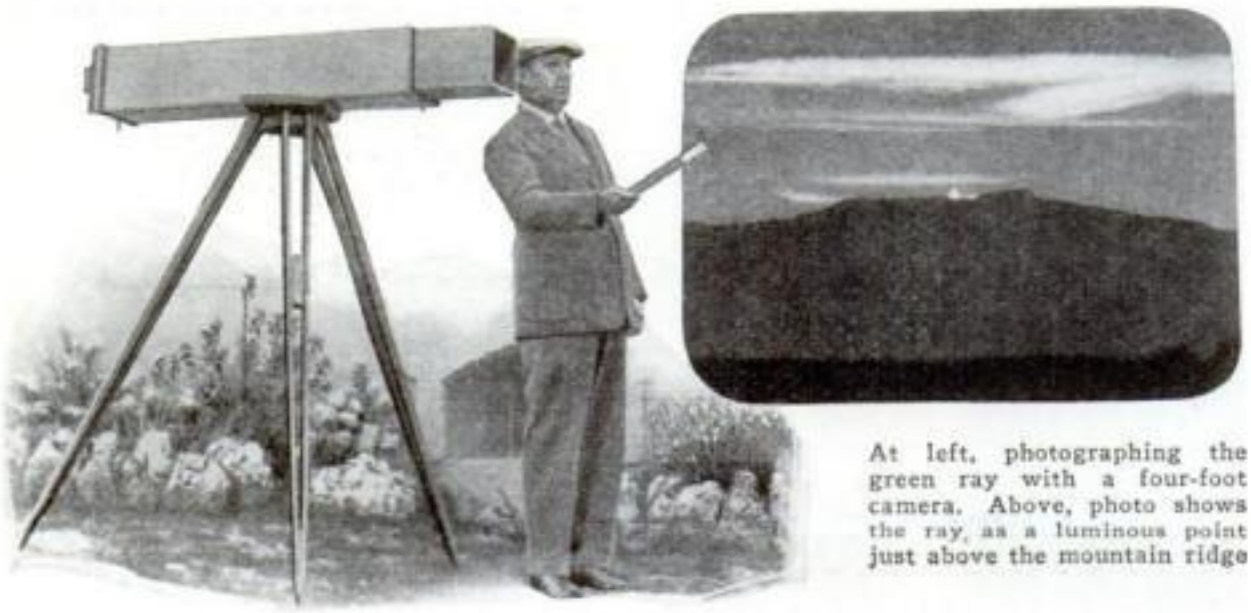
IF YOUR dog makes a nuisance of himself chasing automobiles, a short piece of wood and a bit of chain are all that are needed to produce a device that will, literally, keep him out of the running. The chain is attached to the bottom of the dog's collar and tied to the middle of a section of a broomhandle at the right height to be in line with the animal's knees. As soon as the dash after an automobile begins, the club starts whacking the dog on the knees and his enthusiasm for the sport immediately wanes. The club's usefulness ends, however, if he takes it between his jaws. A dog owner of Park Ridge, Ill., is the originator of the ingenious contrivance.

Copyrighted material

New Sextant Gets Sun's Rays Through Clouds

ORDINARY sextants are useless when the sun fails to shine, but a remarkable new instrument enables the master of a vessel to take his bearings even when heavy clouds blanket the sky. Shipping men hail as revolutionary this all-weather sextant, invented by Paul Humphrey Macneil, a Huntington, N. Y., architect and engineer. It detects invisible infra-red rays from the sun, which penetrate even the thickest haze. Since the human eye cannot see these rays, their presence is revealed electrically through a photo-electric cell and indicated on a dial. A window of special construction permits only infra-red rays to enter the instrument, barring all others.

GREEN MYSTERY RAY IS PHOTOGRAPHED

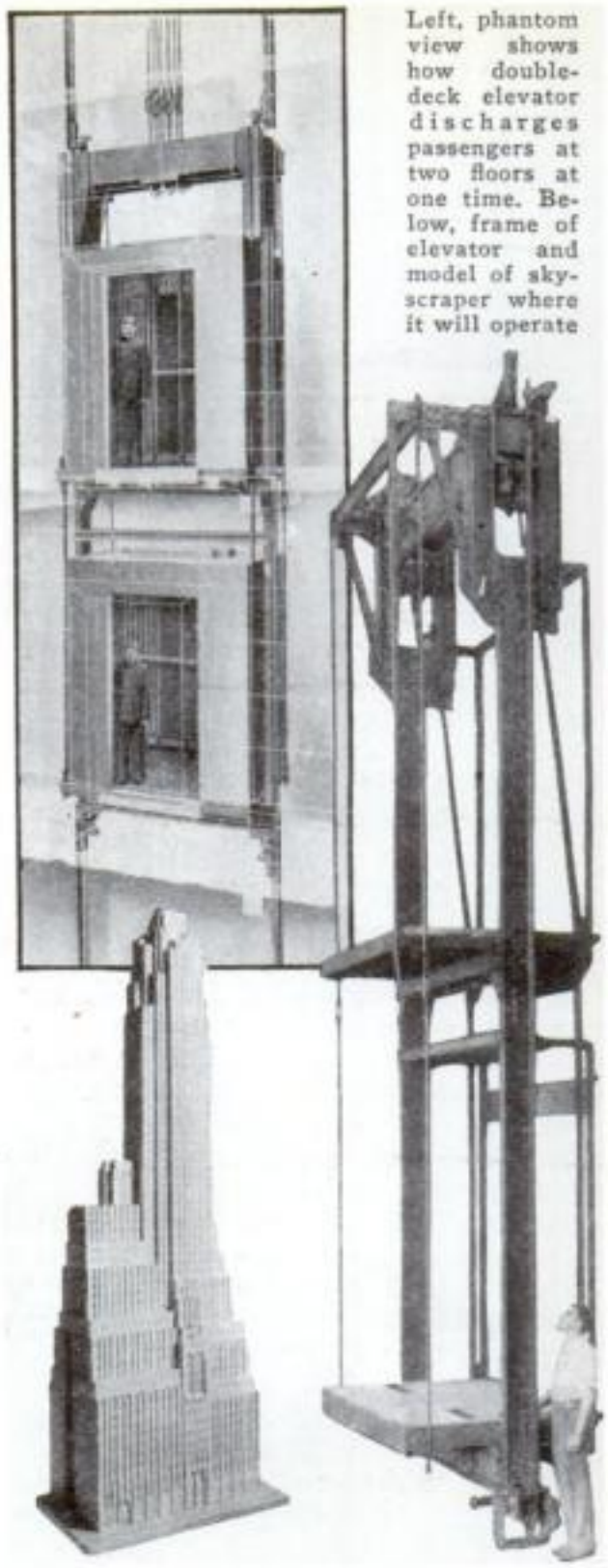


At left, photographing the green ray with a four-foot camera. Above, photo shows the ray, as a luminous point just above the mountain ridge

THE "green ray" that a lucky observer occasionally may see just as the sun's disk sinks below the horizon has just been photographed in colors for the first time by a French astronomer. To picture it, M. de Kerolyr, director of an observatory in southern France, trained his camera on a distant range before sunset. His wife, standing on a balcony, gave him the signal to snap the shutter just at the right moment. Several trials were necessary, as the light is visible at its height for barely a fifth of a second. The green ray is the last visible part of the sun's spectrum, produced by diffraction of light at the horizon and resembling in appearance the effect when a glass prism splits sunlight, or drops of water form a rainbow.

LIGHTNING STUDIED UNDER METAL DOME

A MYSTERY dome of metal in a meadow not far from Breslau, Germany, awakens the curiosity of visitors there. It houses the latest secret experiments in tapping the power of lightning, according to reports. The work is a continuation of recent tests at Mt. Generoso, in the Italian Alps. Here daring German experimenters succeeded in capturing an 18,000,000-volt thunderbolt from the clouds, and tried out experimental models of vacuum tubes to harness these enormous currents (P. S. M., Sept. '31, p. 26).



Left, phantom view shows how double-deck elevator discharges passengers at two floors at one time. Below, frame of elevator and model of skyscraper where it will operate

TWO-DECK ELEVATORS PUT IN SKYSCRAPER

THE world's first double-deck elevators have just been installed in New York City's newest skyscraper. They will enable eight elevator shafts to do the usual work of fourteen in the Cities Service Building, third highest in the world, with a tremendous saving of valuable floor space. At the ground floor, passengers will enter the elevator at two different levels, one cab serving odd-numbered floors and the other the even numbers. When the elevator stops on its way up, passengers for two floors are thus discharged at once. Each cab has its own operator. The elevator will start only when the operating handles of both compartments are in "start" position and all doors are closed. The national elevator code was revised especially to permit the novel installation. According to Otis Elevator Company engineers, who designed the two-story elevator, the ability to handle twice the usual number of passengers in a single shaft may effect radical changes in the design of tall buildings. A different means of attaining the same end, by running two separate elevators in a single shaft, has already been successfully demonstrated by an installation in an East Pittsburgh, Pa., building (P. S. M., Apr. '31, p. 71).

Copyrighted material

Scroll saw, with its blade two feet distant from frame, has sanding device to speed final work

NEW SCROLL SAW HAS A SANDING ATTACHMENT

ESPECIALLY adapted to the needs of the amateur mechanic is a versatile scroll saw that has recently appeared on the market. With a sanding attachment, held in the chuck in the same manner as the saw blade, work can be sanded smooth immediately after scroll sawing. Hitherto this has required tedious hand work. Files of various shapes for wood and metal work are also held in the chuck. The two-foot distance from saw blade to frame accommodates large work. The blades' high speed insures clean sawing.

NEW ELECTRICAL ROBOT FINDS TROUBLE IN CAR

ITS FACE made of dials and lamps, an electrical robot invented by a San Francisco engineer is said to diagnose a car's ailments in five minutes. A voltmeter in the left eye and an ammeter in the right one test the car's battery and ignition system. The nose is a vacuum meter for checking the condition of the valves and the vacuum tank. A slot just below serves as a spark gap indicator, while the teeth are neon tubes that show the intensity of the spark in each individual cylinder. The apparatus is portable and can easily be moved from one automobile to another in a garage.

ENGLISH FERRY WALKS ON SEA'S FLOOR

A STRANGE ferry that walks on the sea bottom is England's newest curiosity. It conveys guests between an island hotel and the mainland near Bigby, on the southwest coast. Whether the rising tide is sweeping over the intervening flat or has receded, leaving a mushy footing, this remarkable vehicle has no difficulty in crossing. Its passengers ride on an elevated platform, high above the tractor-ferry's wheels and the endless treads that propel it. The motor is also well out of the water's reach, and transmits its power through a chain drive, as shown above.

FACTORY WORKERS USE PORTABLE PHONE BOOTH

WHEN they wish to phone in peace and silence, workers in a German factory trundle up a perambulating telephone booth on wheels. Its thick walls and doors, of sound-absorbing material, make a conversation possible despite the din outside. The photograph below shows the invention in try-out at a Hamburg plant.

Portable telephone booth used in factory to shut out noise

RARE MINERAL YIELDS PRICELESS ELEMENT

BY EXTRACTING a few grains of the hitherto unobtainable element Ekacaesium from a velvety black mineral known as samarskite, Dr. Jacob Papish, professor of spectroscopy at Cornell University, recently accomplished what has been hailed as an outstanding pioneering feat.

The grains, containing this element in the form of a sulphate compound, are considered priceless. Experiments indicate that if the element itself can be isolated from its compound, it may prove to be the world's best material for coating photo-electric cells or "electric eyes" to make them sensitive to light. Because of its instant inflammability in pure form, which is believed to be a silvery metal, it has not yet been isolated.

Ekacaesium, also known as Element No. 87, was the last but one of the ninety-two chemical elements to be discovered. It was detected only last year at the Alabama Polytechnic Institute by Dr. Fred Allison and Edgar J. Murphy, who made no attempt to extract it.

The remaining "missing element," No. 85, was found by the same men this year, completing the roll of the elements (P. S. M., Sept. '31, p. 35). Extracting this extremely rare element, known as "Eka-iodine," in pure form will doubtless be the next goal of chemists. It is expected to be a shining, black solid, possibly radioactive like radium.

Copyrighted material

BLASTING OUT ROCK

At right, the beginning of a big blast. Individual charges can be seen throwing up puffs of gas at top of quarry while rock below is being shattered

An "angel buggy" loaded with nitroglycerin is pushed slowly and carefully from storage to dynamite mixing house. It has rubber tires and is rubber lined

DYNAMITE'S *Makes Impossible*

"FI-YAH! Fi-yah!" You've all heard this cry—the warning that a "shot" of dynamite is about to be fired. Generally it is uttered by a workman waving a red flag. You may have seen him scrambling out of the cellar excavation for a new building. Maybe he has stopped you while you were driving through the country.

He is always treated with respect. Strung-out lines of traffic halt before the authority of his flag. Pedestrians stop at his cry. When all is clear he gives a signal to a co-worker standing some distance off with a boxlike contrivance at his feet. This man pulls upward at a handle on his box, then he presses it sharply downward.

There is the muffled thud of an explosion. Workmen swarm over the heap of logs covered with a heavy mat that have been spread over the charge to keep rocks from flying wild. Pulling aside the protective covering, they expose the nest of shattered rock caused by the blast. Part of the stony outcropping that impeded progress has, through the power of dynamite, been reduced to pieces of a size convenient for men and machines to handle.

To many people such blasts represent the general use of dynamite. They are, though, but small and unimportant examples of the use of industrial explosives. The alarm clock which got you up this morning, the range on which your breakfast was cooked, the gas it burns, and the car or train that takes you to work are made of materials ripped out of the earth by the rending force of high explosives.

Curiosity about this giant force led me, not long ago, to visit a dynamite factory. Early one morning I landed at what seemed a large oil dock on the New Jersey shore of the Delaware River. Here were tanks on steel stilts, a maze of overhead piping and the tall chimneys of power houses. Behind this as far as the eye could see seemed nothing but waste land.

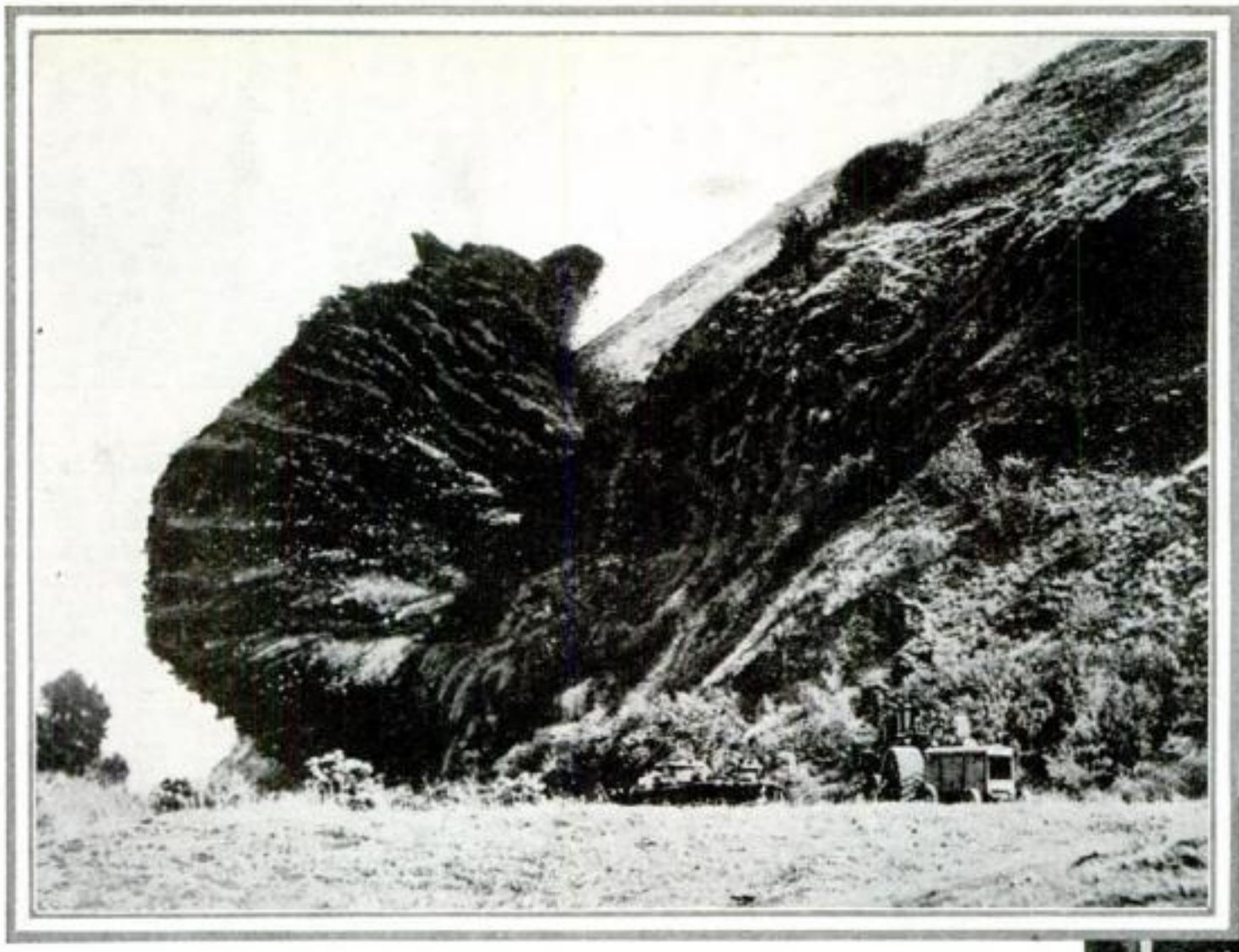
"We are now in one of the safety areas," said my guide, an explosives expert of long experience. "These tanks are storage containers for acids that are nonexplosive by themselves." With a wave of his arm that seemed to embrace the entire horizon, he explained that the danger areas lay in what seemed waste land.

I learned that the plant extended inland over an area of about 24,000 acres. We hopped onto a passing locomotive, which with its flaring stack, containing a spark arrester, suggested locomotives used in Civil War times. We passed through what seemed an immense park. At widely-separated intervals were groups of trees, with the tops of low buildings peeping over them. I was told that a dynamite plant was thus spread out for safety's sake. So terrific are the forces involved in the manufacture of explosives that all processes are carried out in isolated buildings. If anything happens to one others will not be affected.

WE WERE going first to the nitrating house, where nitroglycerin is made. This is one of the chief ingredients of dynamite. Others of importance are nitrate of soda, wood pulp, and for some dynamites nitrate of ammonia or nitrocotton. After a short run we left the engine and walked to a compact structure resembling a frontier fort of Colonial days. An earth and cribbing barricade surrounded it. Unlike Colonial forts, which were barricaded against danger from without, this building was barricaded against danger within it.

Here little tank cars bring carefully-mixed charges of nitric and sulphuric acid. Compressed air blows the acids up to the second floor into a big kettle lined with cooling coils. Two large paddles, driven by a compressed air engine, circulate the mixture against the coils. While the acids are running into the nitrator,

Copyrighted material



By

CLAYTON R. SLAWTER

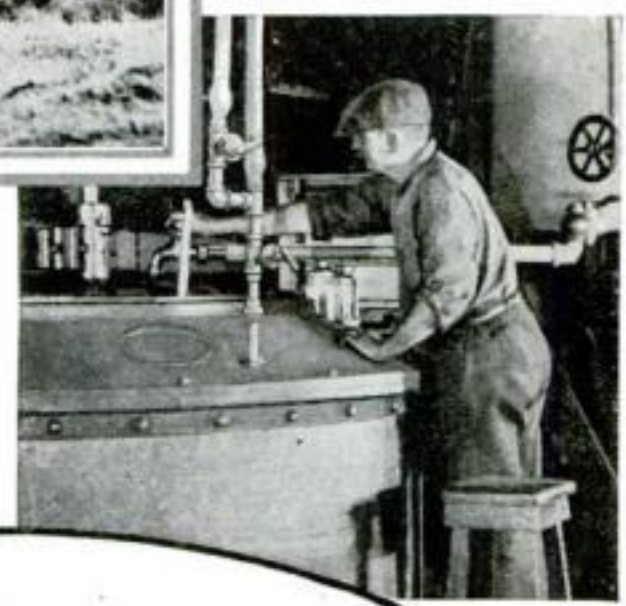
•

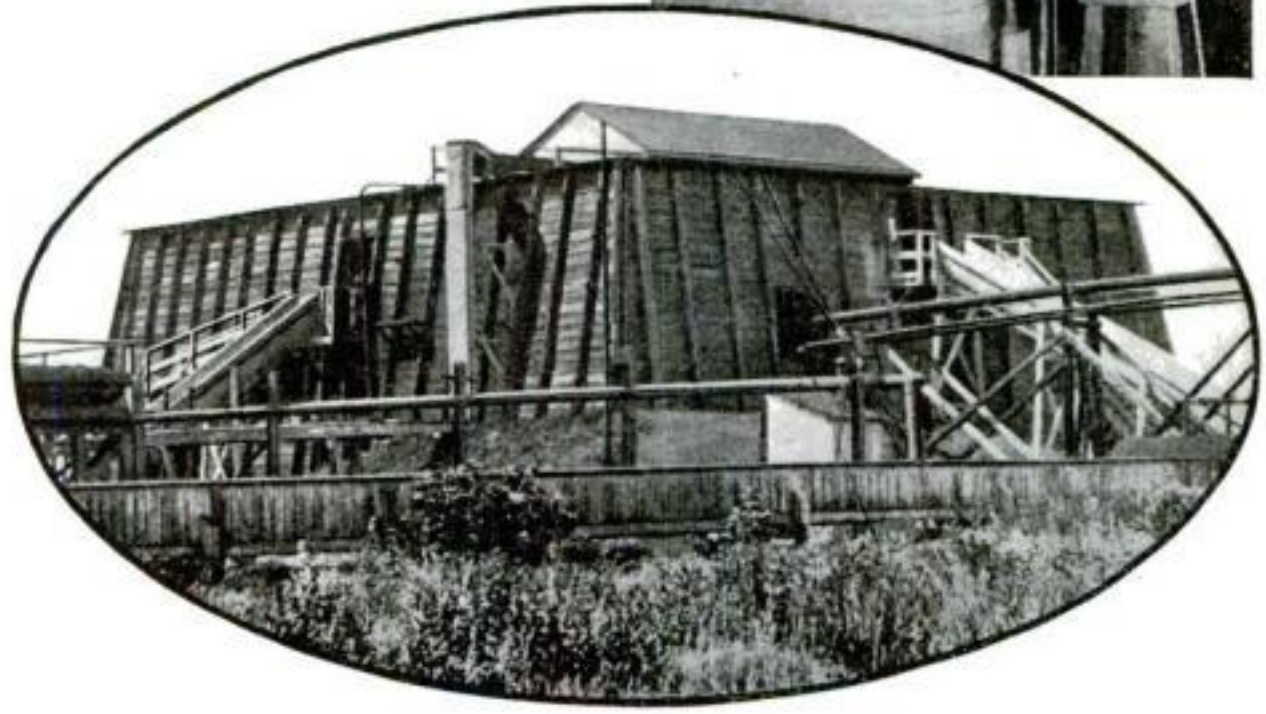
GIANT BEAR CLIMBS A HILL

At left, a great blast of dynamite has just torn off this mass of rock which in general outline suggests a big bear. Note material falling to foot of hill where it is easily gathered

Giant Power

Tasks Easy





Upper right, adding glycerin to acids in nitrating house. In oval, the house in which nitroglycerin is made. Note chutes which are used as emergency exits in case of accident

refined glycerin is blown from a heating tank, in which it has been warmed until it flows easily, into a scale tank.

A workman now runs the glycerin into the nitrator, regulating the flow by hand. The acids react with the glycerin, forming a new substance, nitroglycerin, the "kick" in dynamite that enables men to move mountains, burrow through solid rock, and lift floors of harbors and bays at will. While glycerin is running into the acids, a thermometer on top of the big nitrating kettle is watched carefully.

THIS is the first of the ticklish operations employed in making dynamite. Mixing these acids and the glycerin generates heat which, if it rises above a certain point, will result in an explosion. So the workman fixes his attention on the thermometer as the mixture swirls against the cooling coils.

Here my idea of powder men began to take definite shape. What impressed me was their unhurried efficiency and concentration. From experts who go out over the country to fire big shots down to workmen in the plant, they can make no mistakes. The result is an intentness that I had never seen displayed by the personnel of any other industry.

From the nitrator, the nitro passes through several washing processes. These take place in the separating house and the neutralizer. A green light flashes in the nitrating house to show that the glycerin's first bath is ready in the separating house. A valve is opened and the nitroglycerin starts to run, the speed of its agitation being slowed down as it does so. It runs through a long lead-lined trough roofed over and mounted on stilts that connects the two houses.

We follow this brook of death into the separating house and watch it run into a large tub. A workman peers at it through a sight glass until the surplus acid settles to the bottom, forming a layer under the lighter nitroglycerin. Here again temperature is a matter of life or death to the workers. Thermometers are watched carefully. If the mercury climbs toward the danger point the batch is agitated by compressed air. When spent acids have been separated from the nitroglycerin they are drawn off and the explosive liquid goes to its bath.

This is a tank of agitated warm water. When the nitro has been washed it settles to the *(Continued on page 114)*

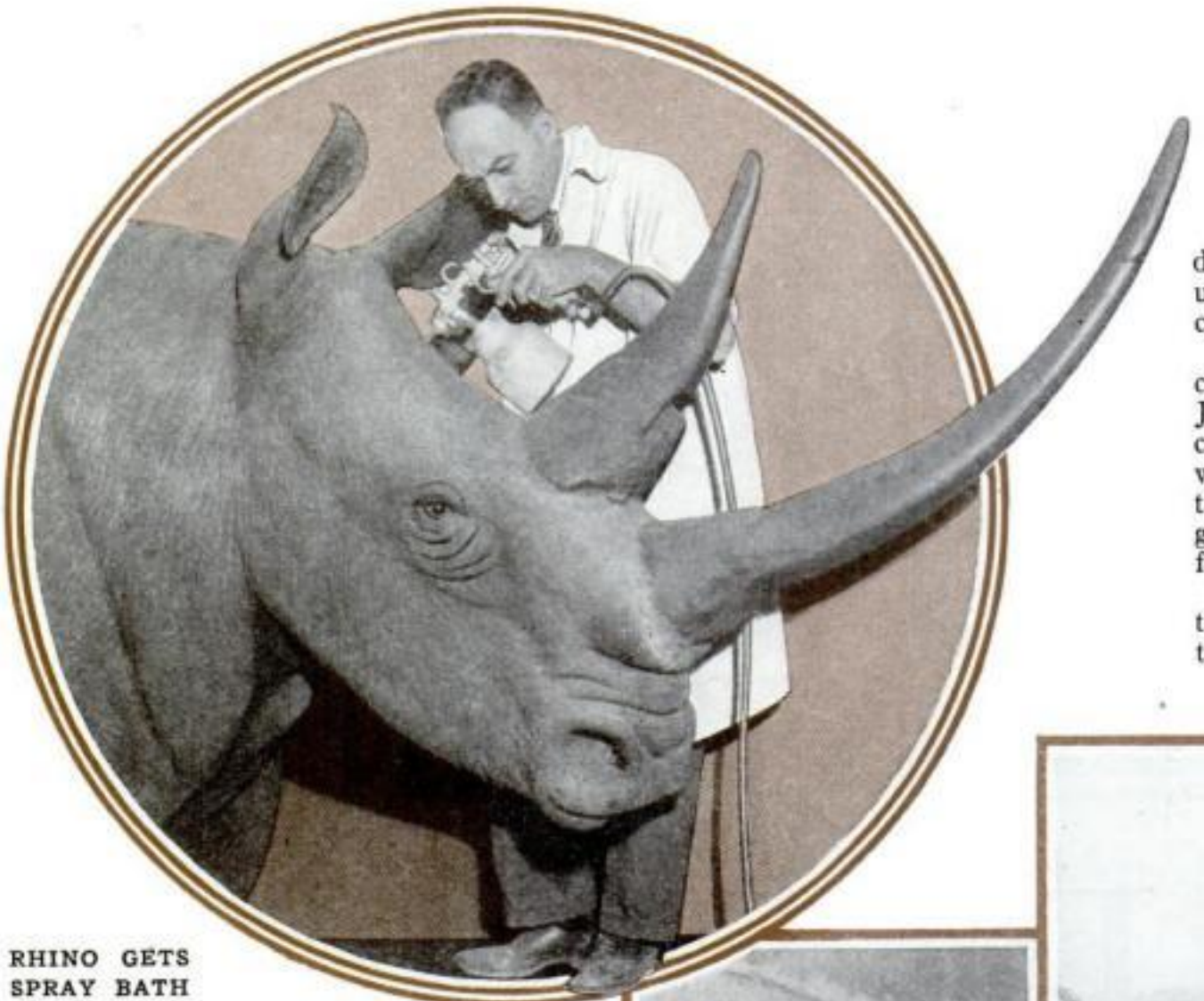
Copyrighted material

New Art Saves Strange Beasts

WHAT a visitor to a museum does not see is the never-ending battle against the ravages of time and other agencies that would quickly destroy rare specimens and irreplaceable exhibits if left unchecked. How experts accomplish the near-miracle of defeating them for decade after decade is revealed in this unusual series of photographs, made especially for POPULAR SCIENCE MONTHLY.

Through the coöperation of the American Museum of Natural History and of James L. Clark, its vice-director in charge of preparation, our photographer was admitted to humming workshops, torrid oven rooms, and pungent fumigating vaults—a veritable preserving factory behind the scenes.

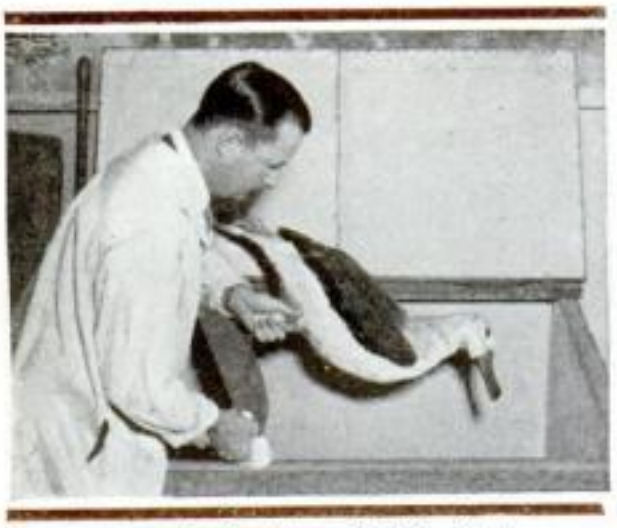
Here the campaign is waged against the legions of bacteria, molds, and insects that constantly threaten the exhibits.



RHINO GETS SPRAY BATH

Hairless animals get a protective coat of a transparent cellulose acetate which is applied with an air sprayer. This foils destructive insects

Looking at this finished group it is hard to realize how jealously it is preserved. Artificial light, less harmful to specimens than daylight, illuminates exhibit



To preserve the feathers of this albatross, the specimen is immersed in a dry cleaner

Scale-covered creatures like the rooster fish, below, are sprayed with cellulose acetate to keep out parasites

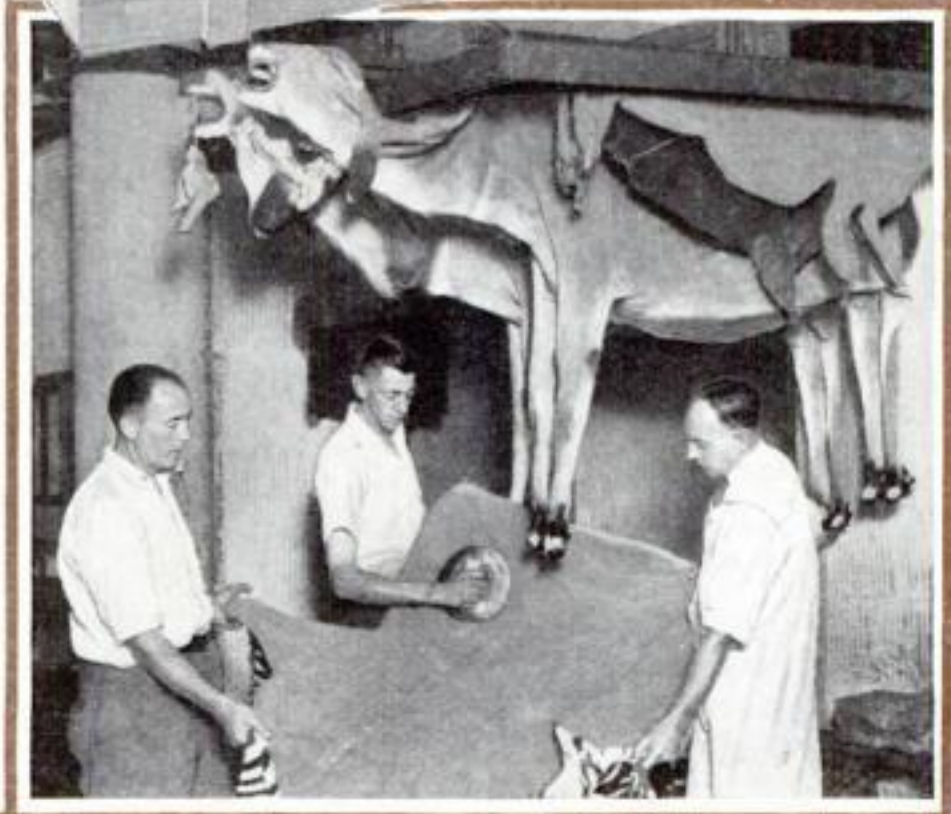
This totem pole is kept bright and shiny with a dust cloth and vacuum cleaner, which are used often

Many parasites can be destroyed by action of heat, and so this steam oven is used on specimens

Copyrighted material

1. The steps in preserving a specimen are shown in photos on this page. Below, taking a zebra skin out of metal lined box in which it was shipped to the museum

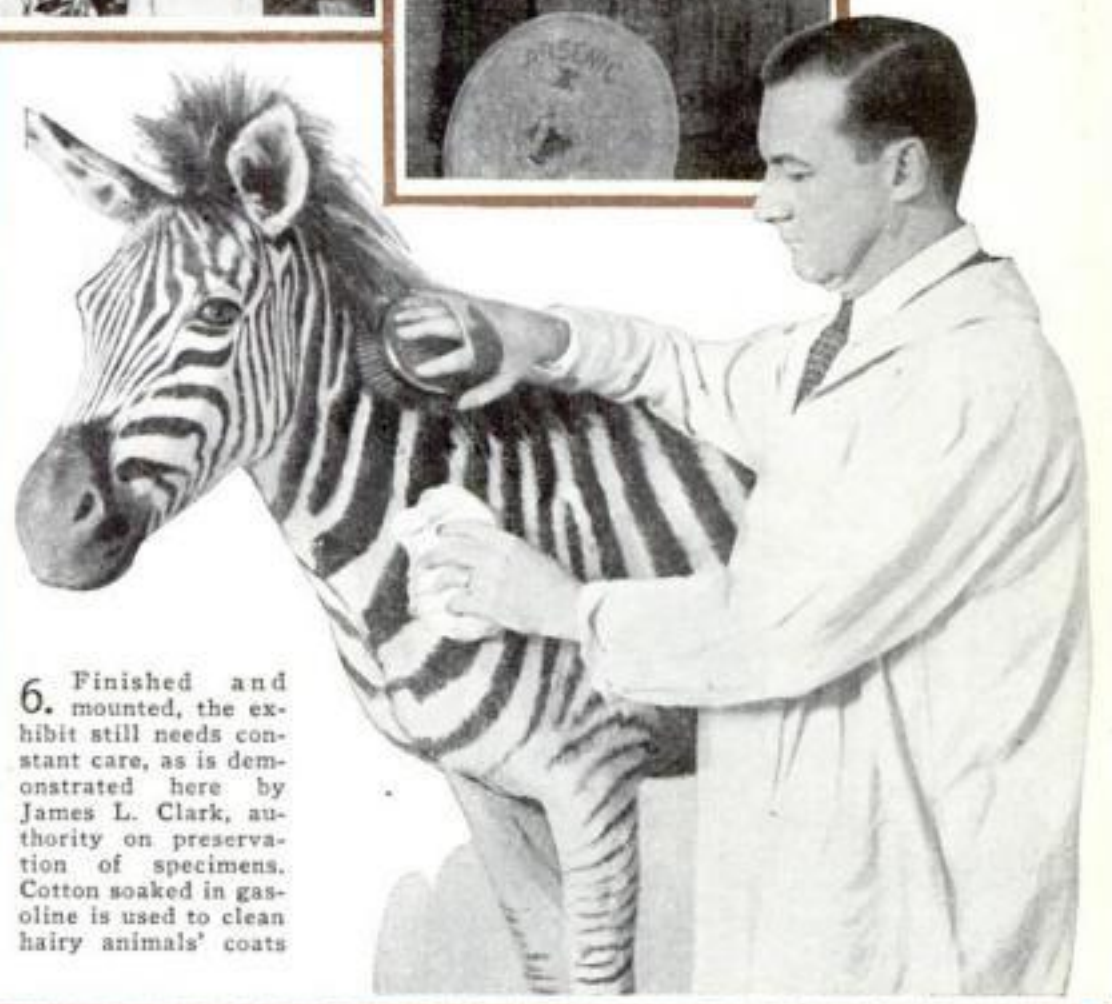
2. The bones are cleaned and bleached, but the skin goes into a revolving drum filled with sawdust and thoroughly cleaned by the friction



3. Cleaned and tanned, the skin is then "mooned" to make it flexible. A circular moon-shaped knife is used

4. Next, the skin is soaked for twenty-four hours in arsenic solution to kill germs

5. While the skin is waiting to be mounted it is kept in a fumigating vault to prevent its becoming recontaminated. There it is exposed to various powerful chemical fumes

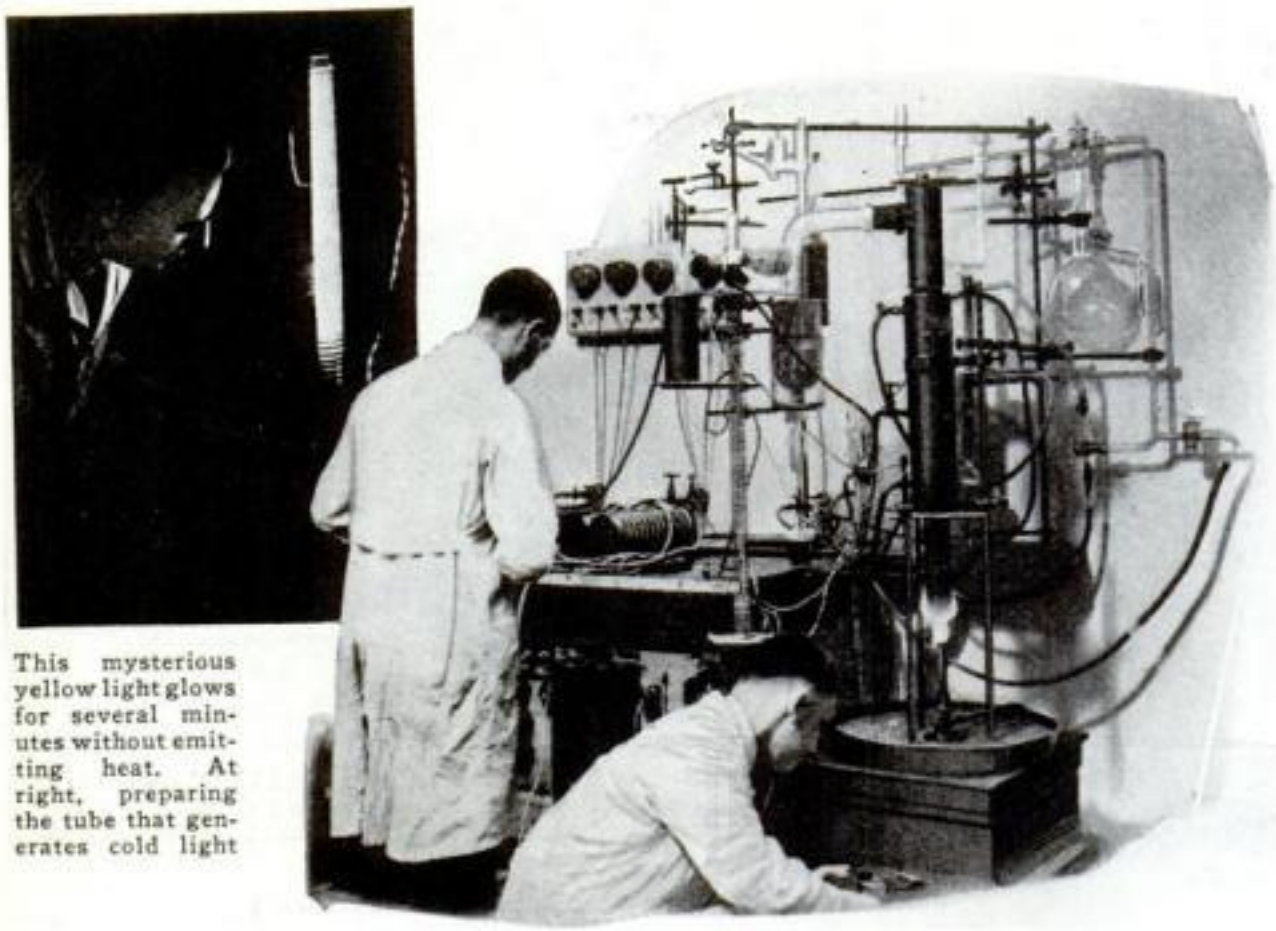


6. Finished and mounted, the exhibit still needs constant care, as is demonstrated here by James L. Clark, authority on preservation of specimens. Cotton soaked in gasoline is used to clean hairy animals' coats

Pictures Tell Story of Preparing Exhibits for the Museum

Copyrighted material

German Produces Cold Light in Special High Vacuum Tube



This mysterious yellow light glows for several minutes without emitting heat. At right, preparing the tube that generates cold light

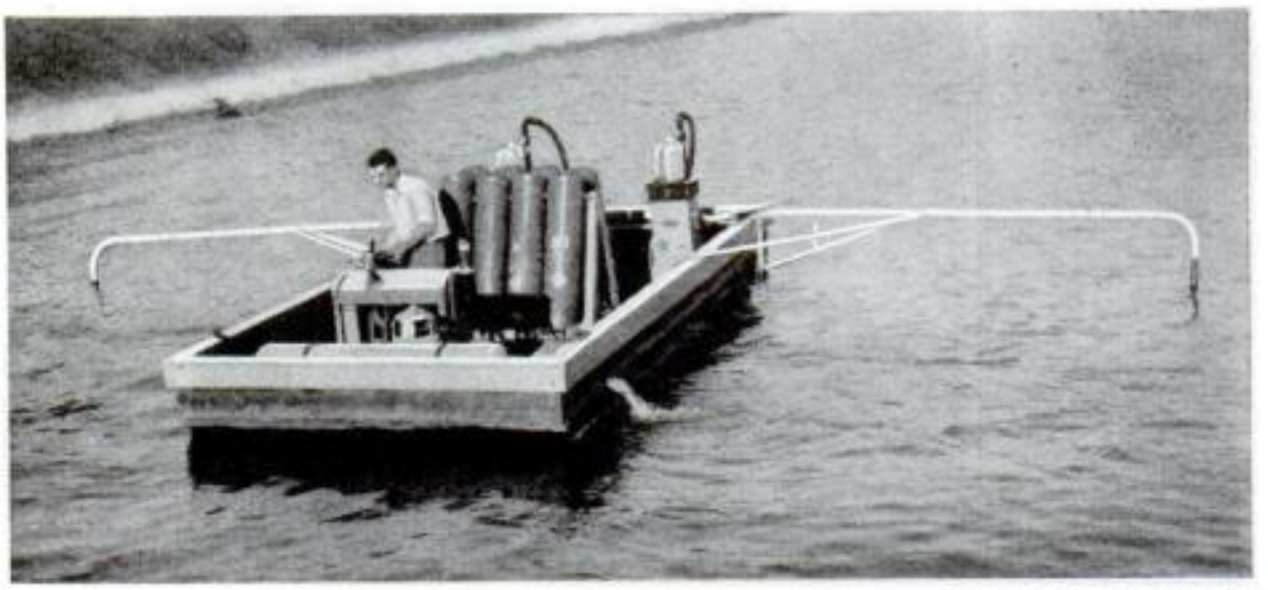
PERHAPS the nearest approach yet made to cold light, the secret of the fireflies, has just been achieved by German scientists at the Kaiser Wilhelm Institute, in Berlin. Hitherto the only known ways to produce light have generated heat as well. When you burn an electric lamp in your home, only a tiny fraction of the current consumed is turned to light; the rest is wasted in the form of unwanted heat escaping from the bulb.

In the new German experiments, however, light is generated by chemical means. Chlorine and sodium, the two constituents of ordinary table salt, are allowed to combine in a special tube that has been exhausted to a high vacuum and chilled with liquid air. When this is done in the dark, a mysterious yellow light of several candlepower begins to glow, and continues for several minutes.

At the end of the glowing, a few pinches of salt are found in the tube. While the present apparatus is far too complicated for domestic use, the experimenters believe the same principle may eventually be applied in household lamps.

CHLORINE BARGE KEEPS CITY'S WATER PURE

NO RIVER, lake, or ocean will ever feel the propeller wash of the newest boat to be added to Los Angeles' municipal fleet. This strange craft, officially known as a chlorine barge, will chug back and forth over the waters of the 100-acre reservoir that supplies the city's water. It will release chlorine gas, compressed to a liquid in eight tilted cylinders, into the water through long spouts. The powerful chemical kills germs and minute growths that have no place in a city water system. The boat is equipped with a twelve-horsepower gasoline motor drives an electric generator, supplying current to two outboard electric motors with propellers that can be turned in any direction.



Chlorine barge with its eight cylinders and long tubes that send gas into a city's water reservoir

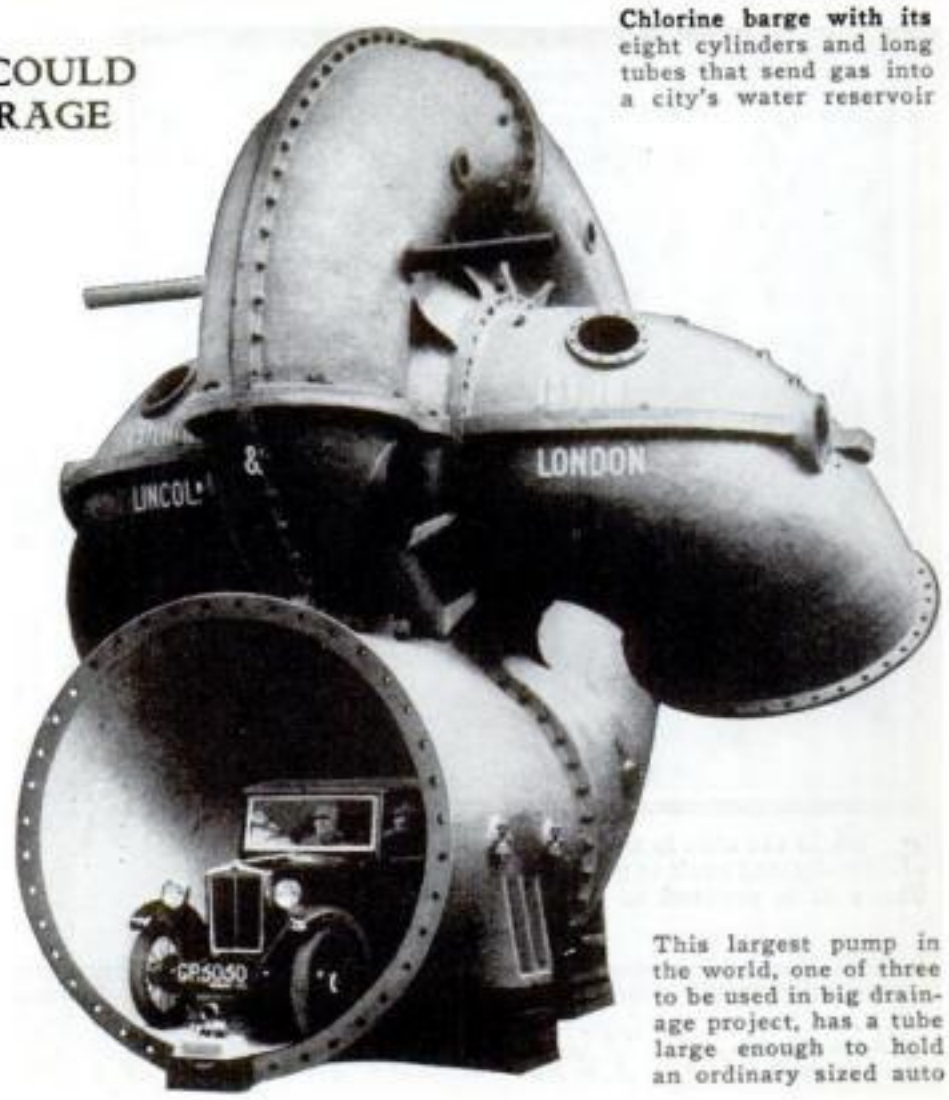
STROP RAZOR BLADE AS YOUR BARBER DOES IT

SAFETY razor blades may be stropped in the same manner that a barber sharpens his blade, with a new holder that is said to fit any make. When the blade is inserted between its two leaves, a clip slides into place to lock it and to provide a rest that insures the correct stropping angle and the proper turning of the blade at the end of the stroke. The device also makes a serviceable handle for an old blade used as a knife to sharpen pencils or clip newspapers and magazines.

Device designed for use in sharpening safety razor blades holds them at exactly the right angle

GIANT PUMP COULD SERVE AS GARAGE

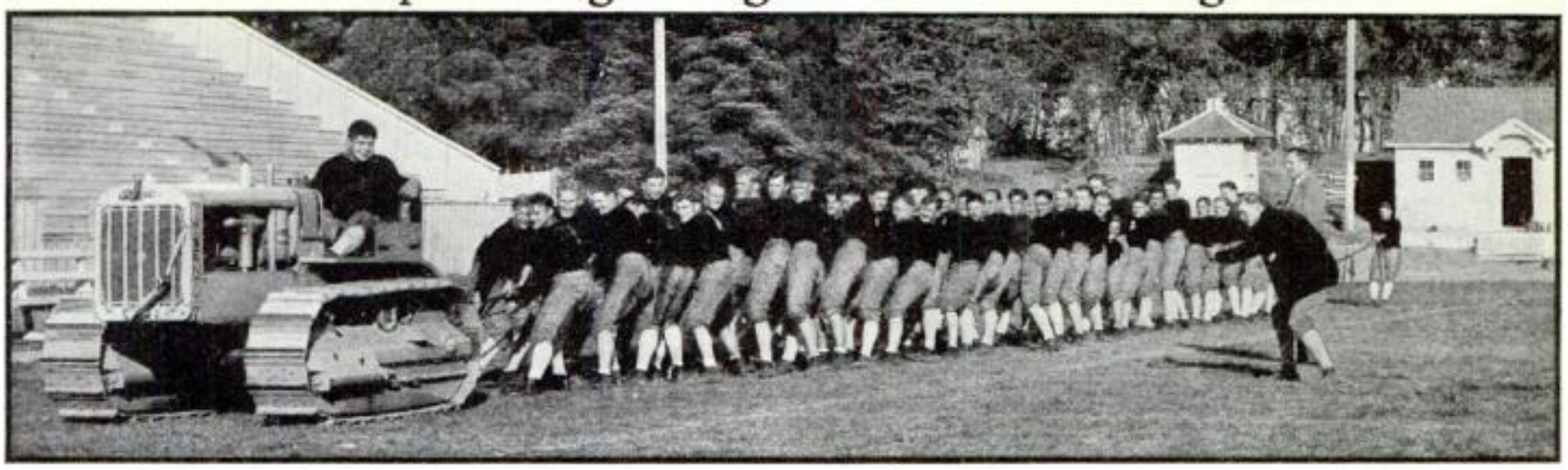
A GOOD-SIZED automobile can rest comfortably within what is said to be the largest pump in the world, first of three of its type to be completed in England. It will be used in a monster drainage project near the North Sea on the eastern coast of Britain. Its amazing capacity of 280,000 gallons a minute is illustrated by the fact that two of these machines could pump New York City's entire water supply. The photograph at the right shows an automobile resting inside the tube of the huge pump, with headroom to spare.



This largest pump in the world, one of three to be used in big drainage project, has a tube large enough to hold an ordinary sized auto

Copyrighted material

Football Squad Stages Tug-of-War with a Big Tractor



Members of this football squad train against a tractor in a strenuous tug-of-war while the coach encourages them to "hold it"

ORDINARILY used for road rolling, a tractor at the State College of Washington has been pressed into service to pull the football squad. A large rope attached to the rear of the tractor gives a handhold for a royal tug-of-war between machine and men. The strenuous exercise of fighting the tractor as it drags them along is proving excellent for keeping the men fit. It strengthens their muscles and also teaches them to "dig in" and get firmly set on their feet.

NEW OFFICE DESK HAS RADIO

A new office desk for the business man has a radio set concealed in one of its drawers

SO THAT the busy executive can listen to the last-minute stock market quotations, and perhaps an occasional sporting event broadcast as well, a new type of office desk has appeared, with a built-in radio set. The receiver is installed in a drawer within convenient reach of the listener for tuning, and disappears completely when it is not in use.

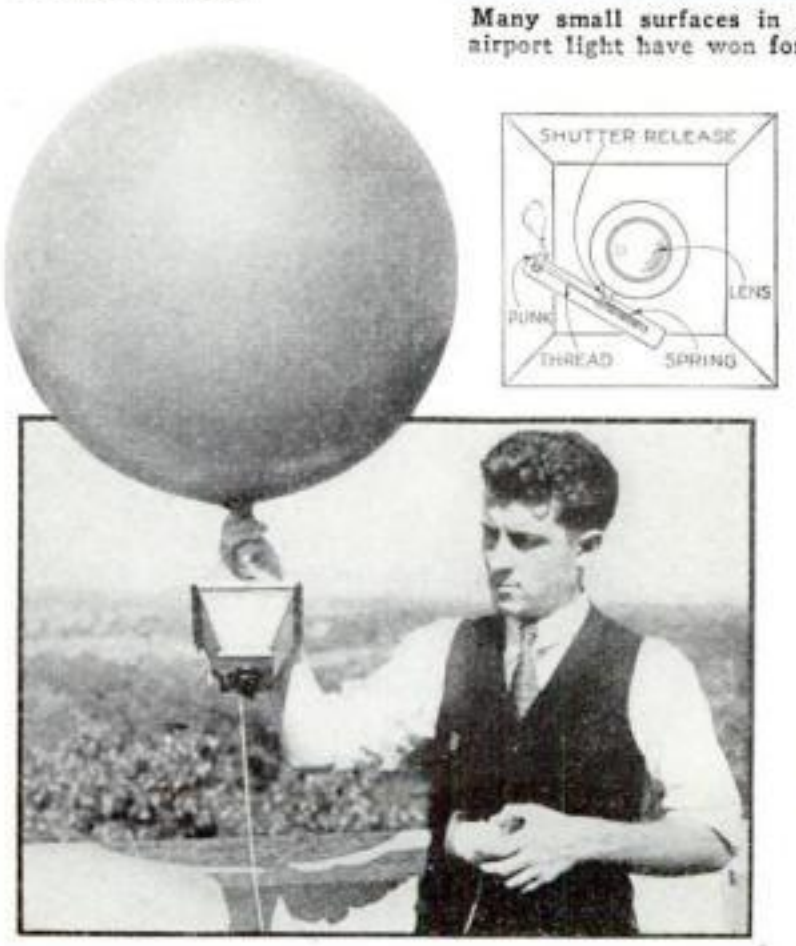
Many small surfaces in these reflectors for fog-piercing airport light have won for them the name of "flies' eyes"

"FLIES' EYES" IN AIRPORT LIGHT PIERCE FOG

EIGHT miles of foggy air was pierced the other day, according to reports, by a beam from a new type of searchlight which was being tested on the southern California coast. Designed especially for airports, the light is said to owe its fog-piercing ability to the number of small surfaces that are combined to form the reflector. Their resemblance to the many-faceted eyes of insects has earned for the devices the nickname of the "flies' eyes." The inventor, Harold G. Fitzgerald, says that a number of the new lamps have been constructed for air fields and Pacific coast lighthouses.

LONG LETTERS IN ROAD SIGNS EASY TO READ

STRETCHING "stop" signs painted on highways to make them legible is advocated by the National Safety Council. Ordinary letters, it points out, are so foreshortened to the eye of an approaching motorist that they can be read only six to eight yards away. This often does not give a driver time to stop. But letters shaped like those in the accompanying drawing appear perfectly square to a person fifteen yards away. This optical effect may be seen by tilting the far end of this page downward.



CAMERA ON BALLOON MAKES AIR PHOTO

A CAPTIVE balloon was pressed into service recently by a Washington, D. C., pilot to get close-up pictures of the ground where he would not dare fly his airplane. To the balloon he attached a camera of his own construction weighing only ten ounces. A spring, a thread, and a piece of burning punk provided an automatic shutter release. To take a picture, the photographer ignited the punk on the camera and paid out cord until the balloon hovered over the spot to be photographed. The punk burned down, severed the thread, and the spring snapped the shutter.

Copyrighted material

Flying Submarine to Travel Six Miles Above the Earth

Germany's first stratosphere airplane, as it appeared when filmed on its maiden flight. Pilot sits in an air-tight cabin

A close-up of from in front of "submarine" plane, designed for flights six miles above the earth

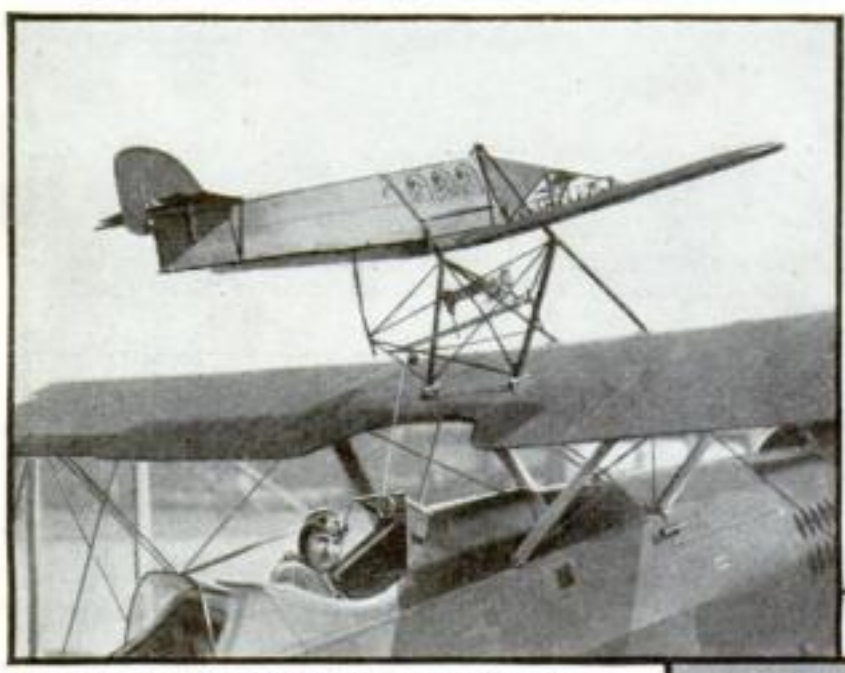
In a sealed cabin, supplied with air from outside by a pump, sits the pilot of Germany's first stratosphere airplane, which recently made its maiden flight at Dessau. His only view of the outside world is through portholes fitted with heavy glass, and his control levers work in air-tight shafts. Flights to an altitude of six miles without discomfort to pilot and passengers from lack of oxygen or lowered air pressure are expected to be made possible by the cabin, in which the pump will maintain normal air pressure.

If the sixty-foot wing spread and 800-horsepower motor of this "flying submarine" carry it to great heights and demonstrate the success of the pressure cabin, a larger plane capable of ten-mile-high flights will be built. Such a plane, flying with decreased resistance in the thin upper air, or stratosphere, could whiz across the Atlantic in a few hours (P.S.M., Jan. '31, p. 53), but its construction has been held up pending tests of the experimental machine.

France, too, is interested in the possibilities of high-speed flight in the stratosphere, and was reported at this writing to be building a sealed-cabin plane. The enormous seventeen-foot propeller of this machine will have to be tilted upward while the plane is resting on the ground.

America's only attempt at fitting an airplane with a pressure cabin for altitude flights was abandoned several years ago, when Lieut. John A. Macready, U. S. Army Air Corps, nearly perished in it. But the Swiss physicist Piccard sailed ten miles high in an air-tight ball attached to a balloon (P.S.M., Aug. '31, p. 23).

'CHUTE LOWERS CABIN OF NEW PLANE



Carried aloft on back of regular plane, this model is used in tests of detachable cabin

First actual tests of a detachable passenger cabin for airplanes are being conducted by the U. S. Army Air Corps at Wright Field, Ohio. Such a cabin, intended to save passengers in case of an accident in flight, has been proposed in the past by more than one inventor but has never before reached the point of practical test. Should an accident occur, the pilot would trip a release and an enormous parachute would lift the cabin bodily from the ship. Then the pilot would make his escape with a regulation 'chute.

The Army's first tests are being made with a small model. A target glider, adapted from a type used in the training of aerial gunners, is carried aloft on the wing of a standard plane and released. It has the detachable cabin and parachute that, if the tests prove successful, may later be built into a full-sized machine. An eighty-foot parachute capable of lowering such a load has been constructed.

At top, drawing shows how parachute would lift detachable cabin from the fuselage of plane. Above, 'chute opens on falling model

USE AIRPLANES TO CARRY COLD SWALLOWS SOUTH

Delaying their annual flight south until a sudden cold spell caught them, swallows in Austria were threatened with destruction (P.S.M., Dec. '31, p. 130). Clever Viennese humanitarians chartered planes, gathered the half-frozen birds in crates and cages, stowed them in the aircraft, as shown above, and sent them south. Freed at Venice, Italy, they were, briefly, a nuisance until they scattered themselves over the near-by country.

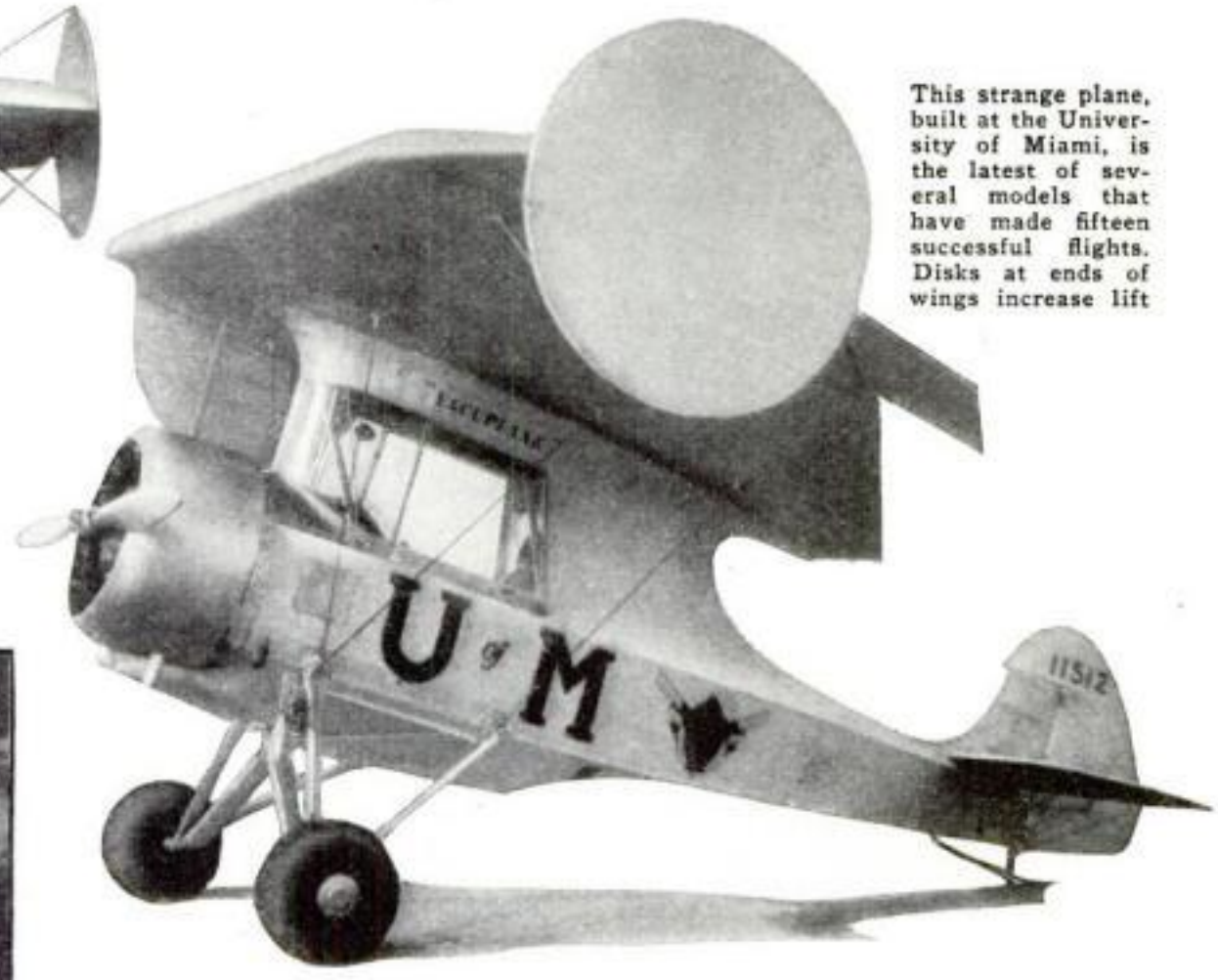
HOVERING SAVES 'GIRO

An autogiro plane staged a demonstration of its ability to hover motionless at a Liverpool, England, airport the other day. Taking off, its tail skid, entangled in a T-shaped ground marker, carried it aloft. The pilot, looking down, saw the shadow of the load on his skid. Descending, he hovered near the ground while an official pulled off the encumbrance.

Copyrighted material

Short Wing Vacuplane Gets Lifting Power from Suction Cells

Above, front view and, below, top view of the new suction vacuplane



This strange plane, built at the University of Miami, is the latest of several models that have made fifteen successful flights. Disks at ends of wings increase lift

THE "VACUPLANE," a strange new type of airplane, has made its appearance at the University of Miami, Florida. Its abbreviated wing, open at the top, is lined with hollow chambers or "suction cells." These are said to make its lifting power equal to a conventional plane of greater wing span.

Several planes of this type have been constructed under the direction of Prof. Fred H. Givens, head of the university's aviation department, following in general the original design of E. H. Lanier, Cincinnati inventor. More than fifteen successful flights have been made. In the latest model, illustrated here, round "tip-loss boards" at the ends of the wing increase the lifting force by preventing the formation of air vortexes. Ailerons that control the plane's banking are mounted on the fuselage behind the propeller.

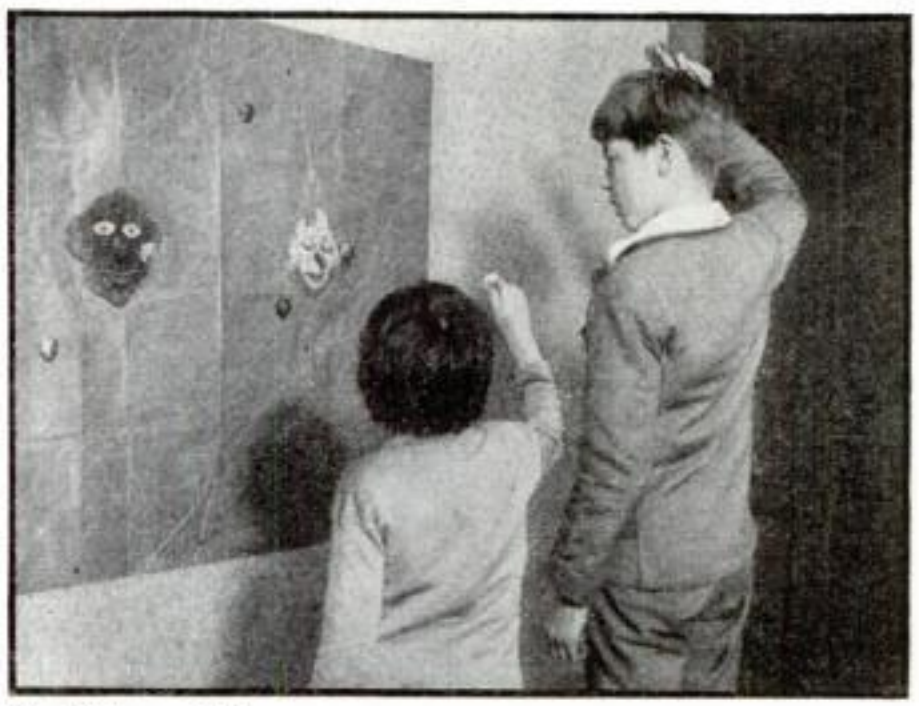
PLANE HAS AUTOGIRO WING

AIRPLANE and autogiro, combined, is a strange craft devised by an Elkhart, Ind., inventor. It achieves this dual role through an upper wing that may be locked rigidly or released so that it is free to spin, during flight, and connected to the rest of the craft by a three-cornered support instead of by the usual struts along the wing.

In ordinary flight the machine resembles a standard biplane, since the upper wing is locked rigidly at right angles to the line of flight. Under these conditions it is said to attain a speed of 145 miles an hour.

In take-offs and landings, however, the upper wing is released and then it spins like the "windmill" blades of an autogiro. With this aid, the craft can descend, according to the inventor, at the comparatively slow speed of twelve feet a second. Thus the novel airplane combines high flying speed with slow landing, factors that have hitherto been considered irreconcilable by aviation engineers.

Upper wing on this biplane can be released to revolve like autogiro vanes



The children satisfy their urge to do as they please in new psychology school

WHIMS RULE PLAYROOM

AMERICAN mothers might look askance at a unique playroom in London, England, where children may smash their toys, play with the dripping water taps, and indulge all the other forbidden longings of childhood. Blocks and building sets are also available. The National Institute of Child Psychology has established this school for problem children. With the rule "No praise, no blame, and no prohibitions," the experimenters believe that a child's real instincts and impulses will be revealed for study.

Copyrighted material

STRANGEST HOUSE BUILT IN ENGLAND

Strange house at left just completed in England. Below, the mushroom-like structure is its water tower

To PROF. BERNARD ASHMOLE goes the distinction of possessing one of the world's strangest homes. The curious structure has just been completed overlooking the town of Amersham, England. Plans for the dwelling were given doubtful approval by building officials, who had never seen any like them before. Its massive shape of white blocks pierced by rectangular windows was chosen to give a maximum of sunshine and view, and to provide outdoor shelter around it no matter from which angle the wind blows. Visitors entering through the hexagonal hallway find the interior finished in modernistic style, and bedroom doors opening off the six-sided upstairs landing are colored green, blue, and silver so that a guest can remember his own room. Behind the house is a curious water tower shaped like a mushroom, combined with a ball court for the professor's small daughters.

GAS IN CAPSULE KILLS TRAPPED ANIMAL

DESIGNED to end the suffering of a fur-bearing animal caught in a steel trap, a "humane trapping capsule" has been invented by a Chester, Pa., man, and recently placed on the market. This device is a container resembling a tooth-paste tube, which is wired to one of the jaws of a trap when it is set. Puncturing the tube releases a gas that is deadly to animals. Since a trapped animal's first act is to bite the jaws that hold it, the gas is immediately effective. Three sizes of capsules are made, of which the first is for skunks, woodchucks, and other small animals; the second, beavers and wolves; and the third, bears and lions.

As shot hits target, number at side jumps out so a marksman can tell where his bullet struck

TARGET RAISES NUMBER AS BULLET HITS IT

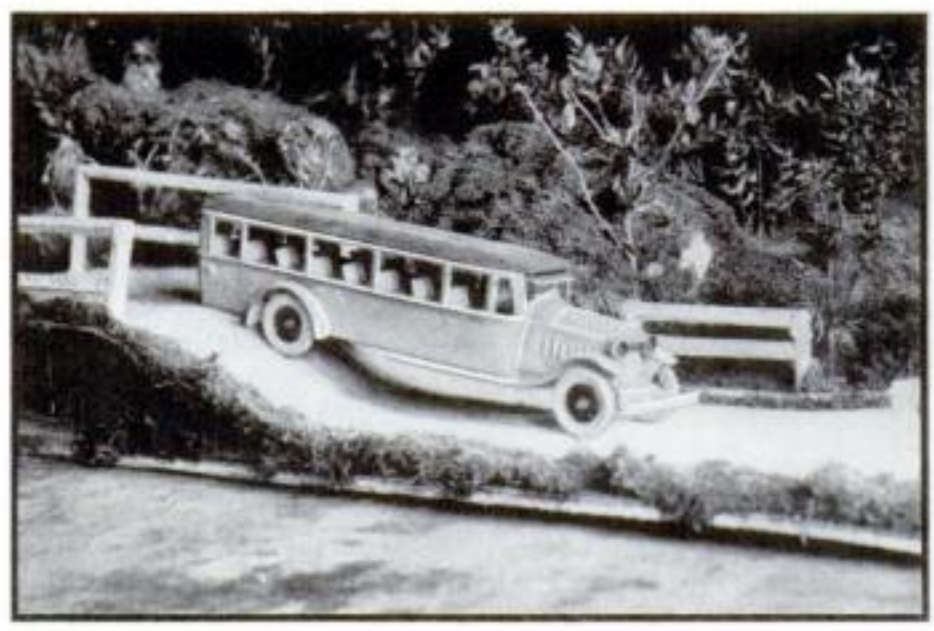
A NEW target invented in Germany makes it easy for the marksman to learn his score. When a bullet hits one of the numbered rings, its corresponding number appears automatically at the side of the target. The rings are made of steel, and a standard paper target is placed over them. Numbers run from one, on the outside, to ten for a bull's-eye. Lead splinters from the bullets fall into a trap.

USE MECHANICAL TASTER TO SAMPLE FRUIT JUICE

EVEN the act of tasting may now be done mechanically. An "electrical taster" is used by an eastern food concern to pass upon the freshness of fruit juice. It resembles a portable radio set. When a sample of juice is poured into a small container and the dials are properly adjusted, the delicate device performs its tasting function. Actually it measures the sample's acidity, which is a close index of its freshness and flavor.

WANTS GLOWING PAINT USED ON ROADS

APPLICATION of luminous paint to danger spots along the highway is advocated by a Boston, Mass., inventor who has built a model to illustrate his plan. The paint, absorbing energy from the sun during the day, would glow at night. He wants fences, curves, and telegraph poles painted. The inventor suggests that large vehicles also be painted so small cars could pass them with greater safety.



This model shows a highway marked with Boston inventor's luminous paint, which he says would make night driving safer

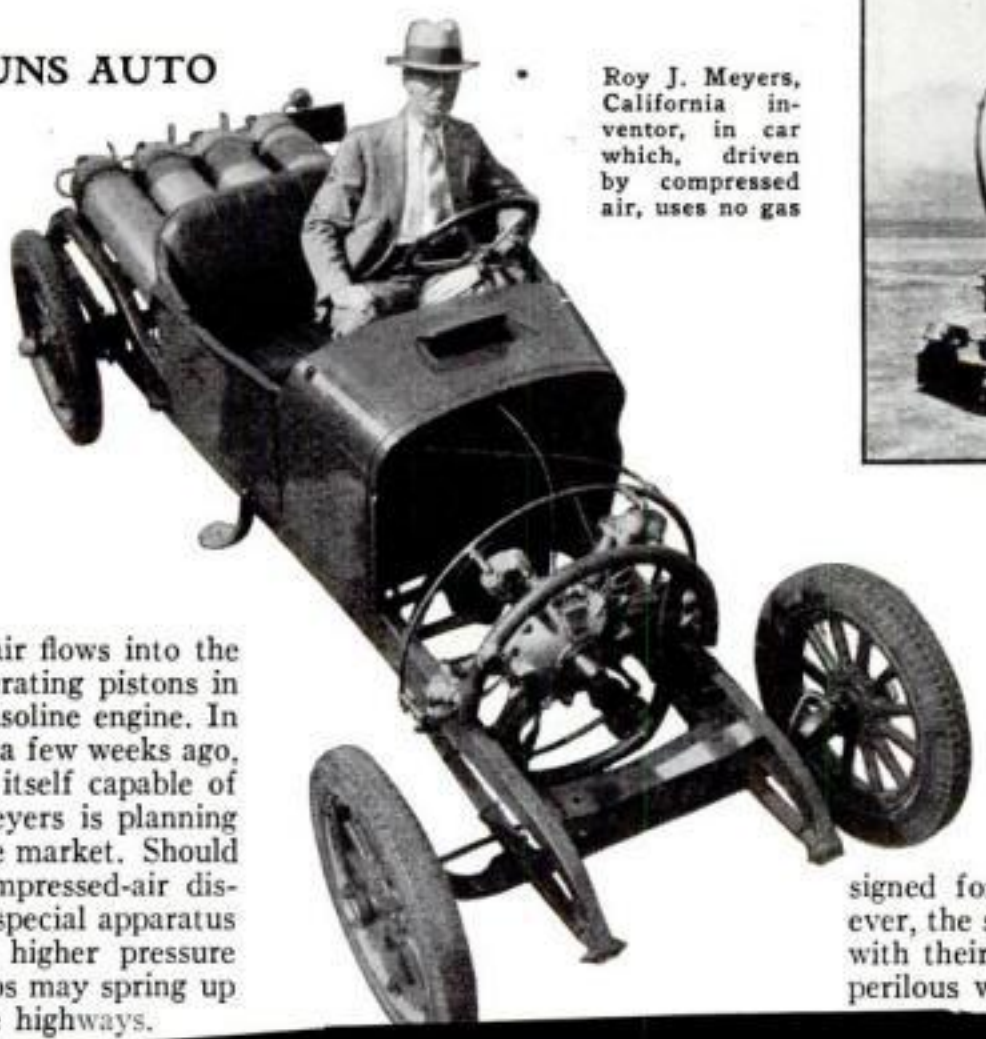
Copyrighted material

Crush 635 Pounds of Ore to Get Tiny Pellet of Gold

Each specimen of iron ore made the cylinder seen with it. The big lump of ore, at left, held enough gold to make the pellet in woman's hand

ROCK crushers throb and blast furnaces roar to extract from masses of ore the comparatively small quantity of valuable metal it contains. Just how much they get is graphically illustrated by a new series of exhibits at the Field Museum in Chicago. One shows a 635-pound specimen of gold ore. The entire quantity of gold that it would yield is shown by a tiny cube of less than three eighths of an inch in thickness, yet this is regarded as a rich ore. Another exhibit, illustrated here, consists of one-pound specimens of iron ore of various types, with pieces of iron equal to their average content. The richest of them, to which the woman in the upper picture is pointing, yields slightly more than eleven and one half ounces to the pound of ore. Reading from left to right, the various iron ores exhibited in this collection are named limonite, hematite, magnetite, and siderite.

COMPRESSED AIR RUNS AUTO



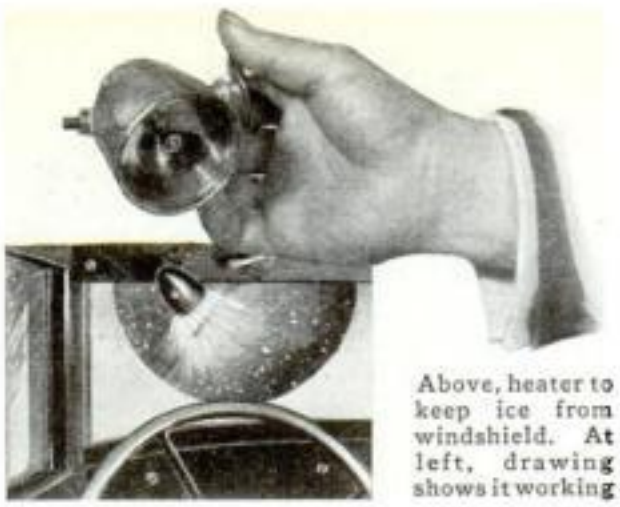
Roy J. Meyers, California inventor, in car which, driven by compressed air, uses no gas

NO DANGER faces Roy J. Meyers, California inventor, of running out of gas, for the remarkable automobile he has invented doesn't use any. It runs on compressed air. Devoid of such working parts as a carburetor or ignition or cooling system to harass the motorist, its machinery is attractively simple. Four tanks at the rear hold the air, compressed to a pressure of 500 pounds to the square inch. When the driver opens the throttle, air flows into the six cylinders of the motor, operating pistons in much the same manner as a gasoline engine. In a demonstration at Los Angeles a few weeks ago, the compressed-air car showed itself capable of thirty-five-mile speed. Now Meyers is planning to put his strange vehicle on the market. Should his plans prove successful, compressed-air dispensing stations equipped with special apparatus capable of supplying air at a higher pressure than that of ordinary tire pumps may spring up beside filling stations along the highways.

OXYGEN KIT FOR MOUNTAIN TOP

MOUNTAIN climbers, seeking to scale such heights as Everest's unconquered 29,000-foot peak, use apparatus to supply the oxygen that the thin air lacks. Latest of the many types of equipment is illustrated here, especially designed for lightness. Even at best, however, the scaling of precipices and glaciers, with their treacherous footholds, becomes perilous with such a load.

Copyrighted material

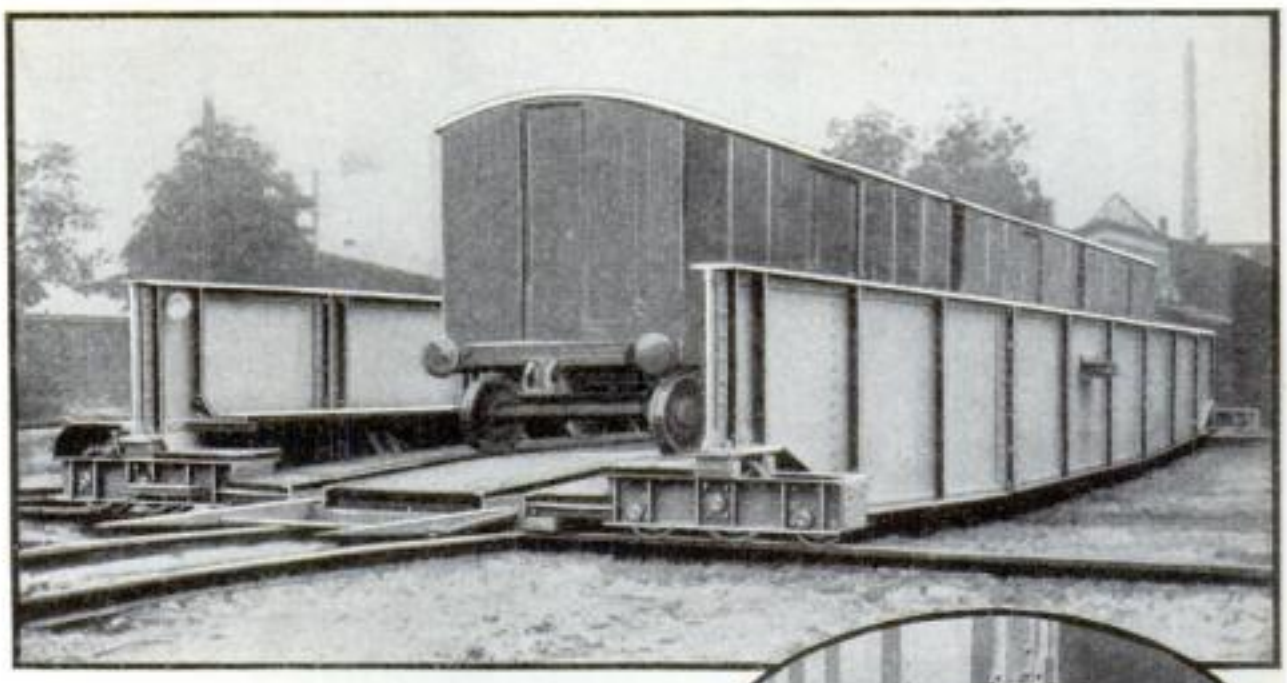


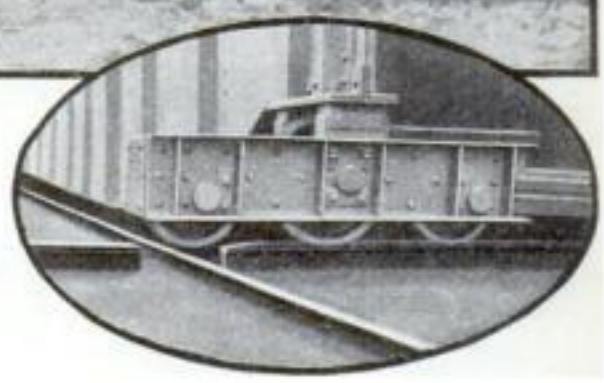
Above, heater to keep ice from windshield. At left, drawing shows it working

NEW CAR HEATER KEEPS ICE FROM WINDSHIELD

A MINIATURE version of the radiant heater that warms a chilly corner at home now keeps sleet from freezing on your car's windshield. This ingenious accessory is mounted just above the windshield, inside the car, and pointed toward the glass. Warmth from its tiny electric coil penetrates the glass and melts ice on the outer surface, enabling the windshield wiper, outside, to do its work properly. It can also be used to keep the inside of the windshield free of fog. Current is supplied by the car's battery.

PLATFORM "SWITCH" MOVES FREIGHT CAR





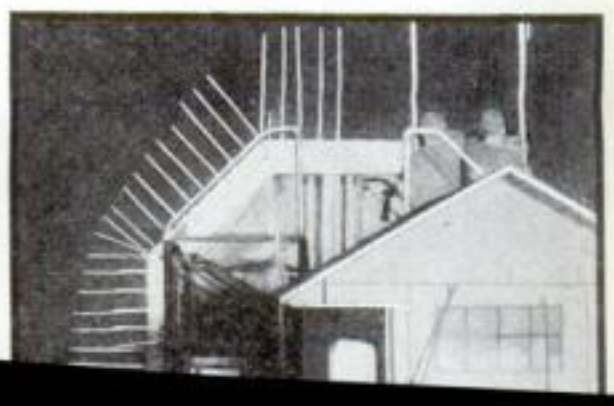
Above, cars spotted on moving platform in railroad yard to be moved from one track to another; right, how platform crosses tracks

WHEN a freight car is to be moved from one track to another in a German railroad yard, it is unnecessary to resort to switching. Instead, the car is pulled or "spotted" upon a moving platform that carries it bodily from one track to another. The newest type of sliding stage, as the device is known, is jerkless in passing over the regular rails because its own are mounted an inch or so higher. An electric winch on the platform pulls freight cars up the slanting approach.

BIG CAR FINDS RAILROAD CLEARANCE

WHEN Pennsylvania Railroad engineers recently wanted to know how big they could make their new electric locomotives for the New York-to-Philadelphia line, and still get them through the tunnels and cuts, one of the strangest of railroad cars was brought out from its home at the Philadelphia yards. Up and down the track ran this "clearance car," bristling with wooden feelers. Just as a cat's whiskers are supposed to tell it how large a hole it can crawl through, so the clearance car's hinged prongs gave the locomotive designers the data they wanted.

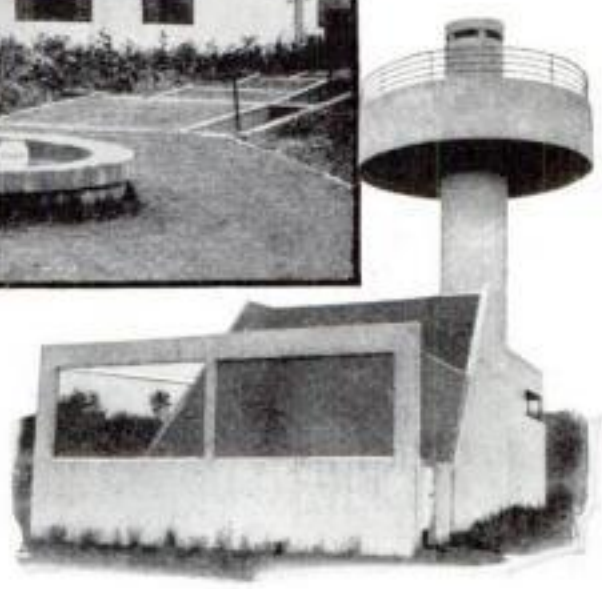
This car's first job was to run over every mile of the company's track, and to date it has gone 75,000 miles. Charts have been prepared showing where every rock, bridge girder, and low bridge on the line came near a passing car. From these charts, railroad officials can tell whether bulky objects can be shipped train. This includes a locomotive, the clearance car, and a business car that serves as a combination office, diner, and sleeper for the three men who take the figures. Slowly approaching a tunnel, they extend the seventy-nine feelers which stick out like the teeth of a comb. Any obstruction pushes the feelers back out of line. An attachment enables the clearance at each feeler to be read off in inches and plotted on a recording sheet.



Copyrighted material

STRANGEST HOUSE BUILT IN ENGLAND

Strange house at left just completed in England. Below, the mushroom-like structure is its water tower



To PROF. BERNARD ASHMOLE goes the distinction of possessing one of the world's strangest homes. The curious structure has just been completed overlooking the town of Amersham, England. Plans for the dwelling were given doubtful approval by building officials, who had never seen any like them before. Its massive shape of white blocks pierced by rectangular windows was chosen to give a maximum of sunshine and view, and to provide outdoor shelter around it no matter from which angle the wind blows. Visitors entering through the hexagonal hallway find the interior finished in modernistic style, and bedroom doors opening off the six-sided upstairs landing are colored green, blue, and silver so that a guest can remember his own room. Behind the house is a curious water tower shaped like a mushroom, combined with a ball court for the professor's small daughters.

GAS IN CAPSULE KILLS TRAPPED ANIMAL

DESIGNED to end the suffering of a fur-bearing animal caught in a steel trap, a "humane trapping capsule" has been invented by a Chester, Pa., man, and recently placed on the market. This device is a container resembling a tooth-paste tube, which is wired to one of the jaws of a trap when it is set. Puncturing the tube releases a gas that is deadly to animals. Since a trapped animal's first act is to bite the jaws that hold it, the gas is immediately effective. Three sizes of capsules are made, of which the first is for skunks, woodchucks, and other small animals; the second, beavers and wolves; and the third, bears and lions.

As shot hits target, number at side jumps out so a marksman can tell where his bullet struck

TARGET RAISES NUMBER AS BULLET HITS IT

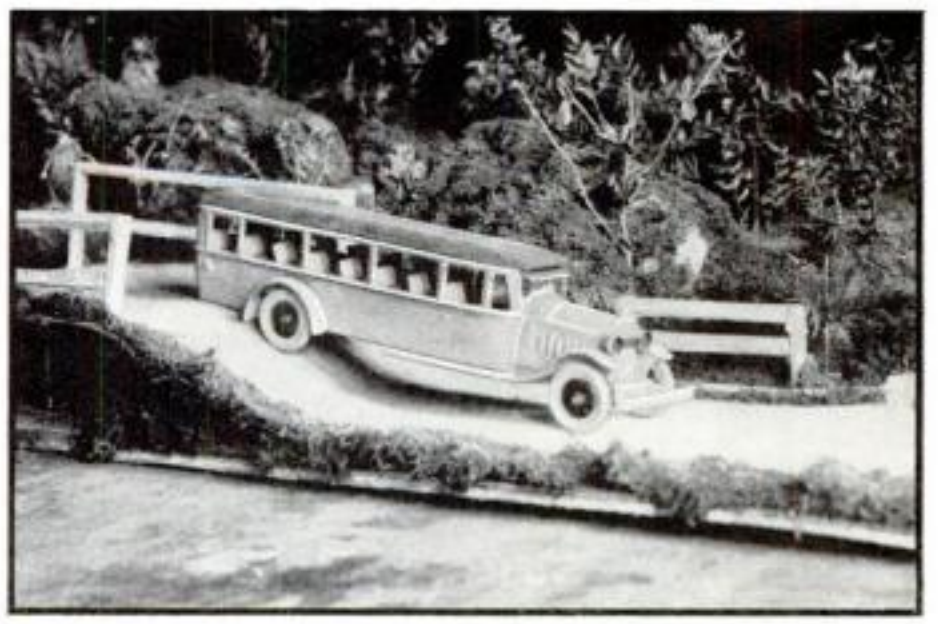
A NEW target invented in Germany makes it easy for the marksman to learn his score. When a bullet hits one of the numbered rings, its corresponding number appears automatically at the side of the target. The rings are made of steel, and a standard paper target is placed over them. Numbers run from one, on the outside, to ten for a bull's-eye. Lead splinters from the bullets fall into a trap.

USE MECHANICAL TASTER TO SAMPLE FRUIT JUICE

EVEN the act of tasting may now be done mechanically. An "electrical taster" is used by an eastern food concern to pass upon the freshness of fruit juice. It resembles a portable radio set. When a sample of juice is poured into a small container and the dials are properly adjusted, the delicate device performs its tasting function. Actually it measures the sample's acidity, which is a close index of its freshness and flavor.

WANTS GLOWING PAINT USED ON ROADS

APPLICATION of luminous paint to danger spots along the highway is advocated by a Boston, Mass., inventor who has built a model to illustrate his plan. The paint, absorbing energy from the sun during the day, would glow at night. He wants fences, curves, and telegraph poles painted. The inventor suggests that large vehicles also be painted so small cars could pass them with greater safety.

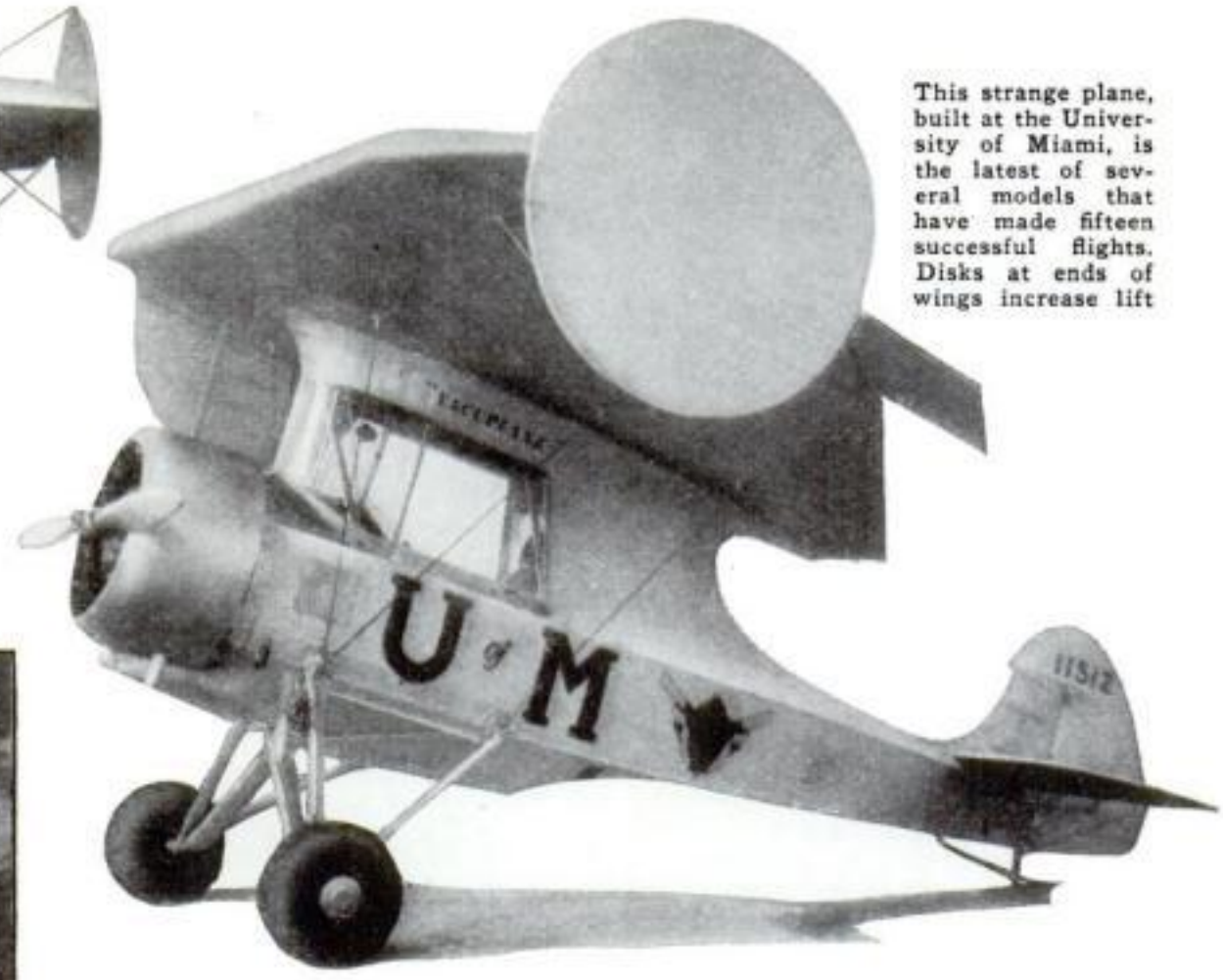


This model shows a highway marked with Boston inventor's luminous paint, which he says would make night driving safer

Copyrighted material

Short Wing Vacuplane Gets Lifting Power from Suction Cells

Above, front view and, below, top view of the new suction vacuplane



This strange plane, built at the University of Miami, is the latest of several models that have made fifteen successful flights. Disks at ends of wings increase lift

THE "VACUPLANE," a strange new type of airplane, has made its appearance at the University of Miami, Florida. Its abbreviated wing, open at the top, is lined with hollow chambers or "suction cells." These are said to make its lifting power equal to a conventional plane of greater wing span.

Several planes of this type have been constructed under the direction of Prof. Fred H. Givens, head of the university's aviation department, following in general the original design of E. H. Lanier, Cincinnati inventor. More than fifteen successful flights have been made. In the latest model, illustrated here, round "tip-loss boards" at the ends of the wing increase the lifting force by preventing the formation of air vortexes. Ailerons that control the plane's banking are mounted on the fuselage behind the propeller.

PLANE HAS AUTOGIRO WING

AIRPLANE and autogiro, combined, is a strange craft devised by an Elkhart, Ind., inventor. It achieves this dual role through an upper wing that may be locked rigidly or released so that it is free to spin, during flight, and connected to the rest of the craft by a three-cornered support instead of by the usual struts along the wing.

In ordinary flight the machine resembles a standard biplane, since the upper wing is locked rigidly at right angles to the line of flight. Under these conditions it is said to attain a speed of 145 miles an hour.

In take-offs and landings, however, the upper wing is released and then it spins like the "windmill" blades of an autogiro. With this aid, the craft can descend, according to the inventor, at the comparatively slow speed of twelve feet a second. Thus the novel airplane combines high flying speed with slow landing, factors that have hitherto been considered irreconcilable by aviation engineers.

Upper wing on this biplane can be released to revolve like autogiro vanes

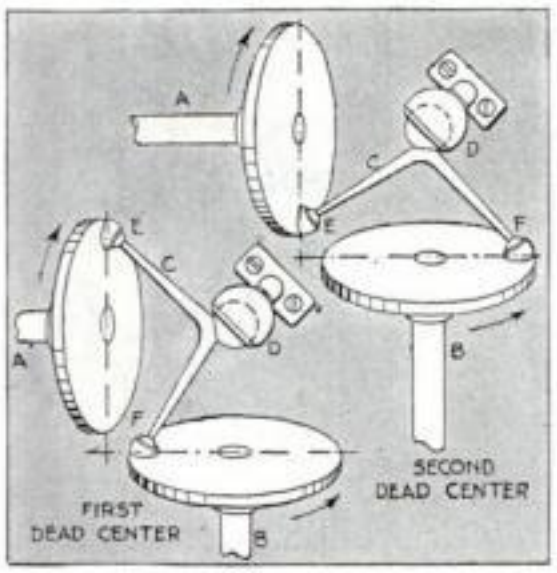
The children satisfy their urge to do as they please in new psychology school

WHIMS RULE PLAYROOM

AMERICAN mothers might look askance at a unique playroom in London, England, where children may smash their toys, play with the dripping water taps, and indulge all the other forbidden longings of childhood. Blocks and building sets are also available. The National Institute of Child Psychology has established this school for problem children. With the rule "No praise, no blame, and no prohibitions," the experimenters believe that a child's real instincts and impulses will be revealed for study.

Copyrighted material

Can You Invent It?

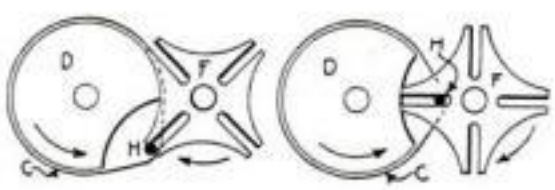


POWER from shaft *A* is transmitted to shaft *B*, at right angles, by means of the bell crank *C*, pivoted on the ball-and-socket joint *D*. But at the two points shown in the illustrations the mechanism must pass "dead centers," at which the joints *E* and *F* on the edges of the disks are in line. These "dead points" may cause trouble in starting and stopping the mechanism. How would you modify or redesign the crank *C*, so that the dead centers will be entirely avoided and a smooth, continuous transmission of power from *A* to *B* result?

• • •

BELOW is the correct solution of the moving picture film mechanism problem given last month. In order to make the star wheel *F* turn the film sprocket one quarter turn for each full turn of the wheel made up of parts *D* and *C*, the following changes are necessary: (1) Four slits are filed in the star wheel; (2) a steel pin is inserted in projection *H*; (3) a segment is cut from disk *D*; as *D* rotates, pin on *H* enters one of the slits, turns the star arm through the segment removed from *D*, and exits from the star wheel slit in the opposite direction, leaving a concave edge of wheel *F* in sliding contact with *D* until pin on *H* again enters next slit on *F*. Was this your way of solving the problem?

Watch this space next month for correct solution of winch problem given at top of column.



Drawing shows correct solution of moving picture film mechanism problem

TINY LAMP FOR LOCAL RAY TREATMENT

LOCAL treatments with health rays are made possible by a tiny mercury-vapor lamp developed in Germany. The housing may be worn as a compress, since little heat is felt, and ultraviolet rays reach the skin through a window. At the back of the box a door permits examination of the fused quartz mercury vapor lamp to make sure the apparatus is operating properly. The small lamp is shown in use at the right.

HAND RESTS FOR WHEEL

LONG drives are made more restful for the driver by a pair of hand grips attached to the steering wheel, according to the maker. The wheel supports the weight of the hands, and a light finger touch on the grips is all that is necessary when the road is straight and without bumps.

BIG SCREW DRIVER IS NO FREAK

A GIANT among screw drivers is this thirty-inch tool. It is not a freak in any sense of the word, as a Philadelphia, Pa., toolmaking concern supplies the mammoth screw drivers to meet the demand for an unusually large model. A double handle makes it possible to use both hands at the same time.

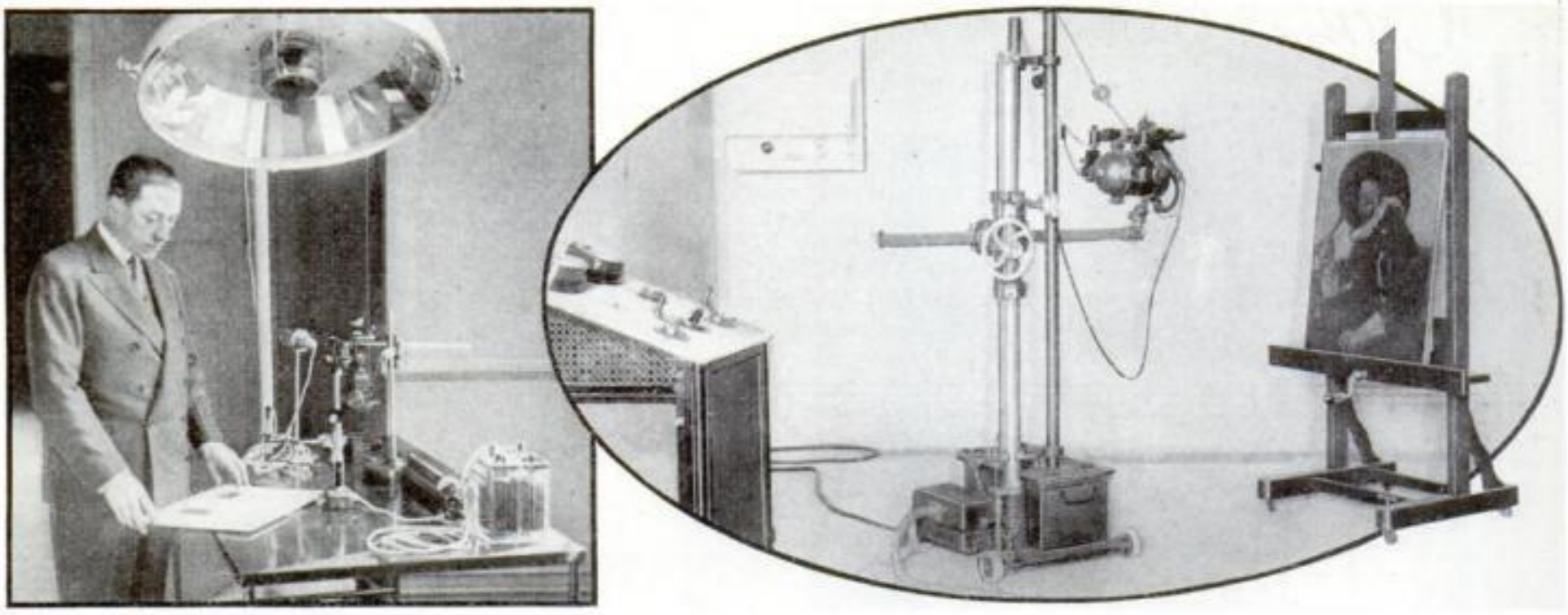
GAS PRESSURE RUNS OIL FIELD PUMPS

A TOPSY-TURVY land is the rich oil field of east Texas, where the pressure of buried natural gas helps bring petroleum to the surface. So plentiful is the gas that it is used like compressed air or steam to drive water pumps. But it would be dangerous in the air, creating a fire hazard, and therefore the exhaust gas is burned. Flames as long as thirty feet flare from the exhaust. Almost to the very point where the flame begins, the pipes are coated with ice and frost from the chilling effect of the rapidly expanding gas, as shown in the photograph.

Three oddities in one picture: Expanding gas drives water pumps, the exhaust is fired to prevent dangerous explosion, and exhaust pipe is ice-coated close to the hot flame

Copyrighted material

First Laboratory in Art Gallery Will Test All Paintings



LONG famous as a repository for some of the world's most celebrated works of art, the Louvre in Paris now boasts what is called the first laboratory for scientific research in the field of painting. In this recently opened department, occupying an entire wing of the museum, exhaustive tests will be given to paintings with camera, X-ray, spectroscope, and chemicals.

These tests are expected to end controversies that have arisen over the authenticity of Rembrandts and other noted paintings. They will determine the exact age of a painting, tell whether or not the artist's method was that of the master to whom the painting is ascribed, and in some cases reveal even the creator's fingerprints.

Other tests will indicate when restoration of a famous painting is necessary to save it from deterioration. The technique of a great artist—how he used his brush and chose his colors, for example—may be analyzed for the benefit of modern students of the masters.

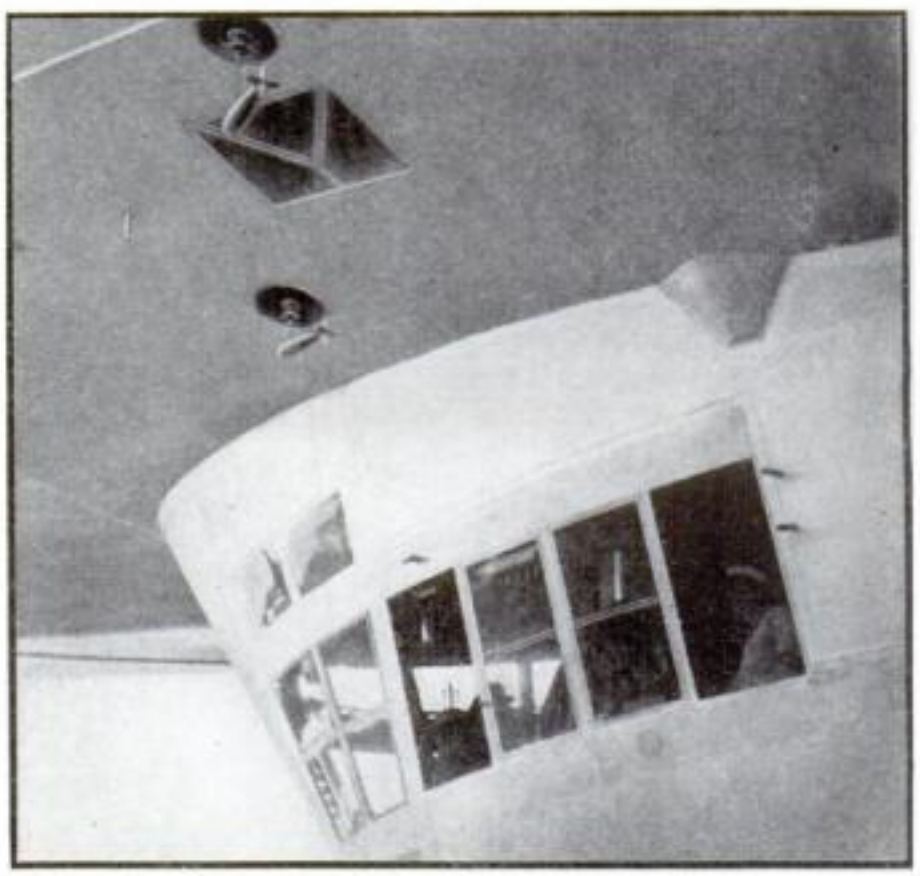
In the photograph at the left, above, is seen a part of the elaborate equipment in the room where microphotographs are made. At the right, a painting is being subjected to an X-ray examination.

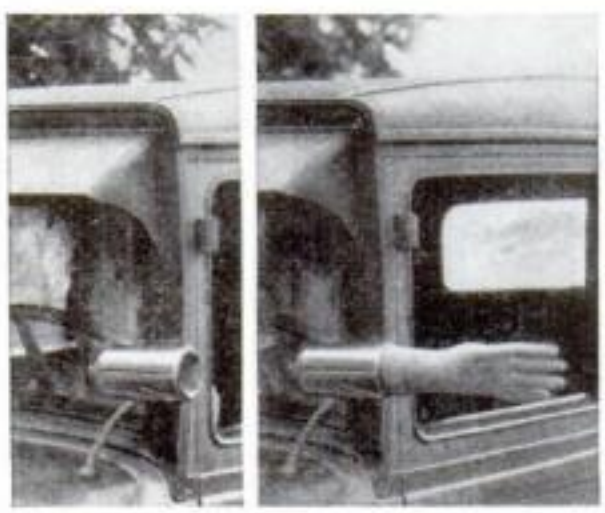
TOY TEACHES ARITHMETIC

BY ARRANGING numbered slips on a graduated scale, in a new educational toy, a child learns the "why" of addition and subtraction. The length of each slip is proportioned to the number it represents. To add four and two, for example, the "4" slip is laid on the scale flush with its base, and the "2" slip added above it. The correct answer, six, is read off at the side of the scale. The idea of representing the size of numbers in this graphic way originated with a professor of mathematics in a Syracuse, N. Y., high school. He has applied for a patent on the toy.

TINY "ZEPS" IN BIG *AKRON*

THE U. S. Navy's new airship *Akron* carries several toy airships on every flight that it makes. Two of these can be seen in the photograph at the right. Although toys in size and construction, they serve the highly useful purpose of holding the ship's radio aerials taut. The weights, weighing several pounds each, are streamlined and equipped with fins to prevent twisting of the aerial wires. Their shape is similar to that of the *Akron*.





At left, holder in which warning glove is concealed until air forces it out as seen at right

INFLATED RUBBER HAND WARNS CARS OF TURN

A RUBBER hand inflated like a toy balloon, to serve as a warning signal for motorists, is the invention of a Greenwood, S. C., man. When the driver is about to turn or stop, he presses a convenient button. Out pops the pneumatic hand from its metal container, warning oncoming cars. It is extended by a miniature pump, operated by the suction of the intake manifold, and it collapses when the suction is applied directly. A lamp within the housing illuminates the hand at night and keeps it from freezing stiff in cold weather.

Copyrighted material

ILLUMINATED TULIPS HONOR EDISON

ILLUMINATED tulips graced the city of Haarlem, in Holland, during a recent pageant of lighting. Lining one of the streets, they provided light for pedestrians and an unusual spectacle for tourists. The display was a memorial to America's electrical genius, Thomas Alva Edison.

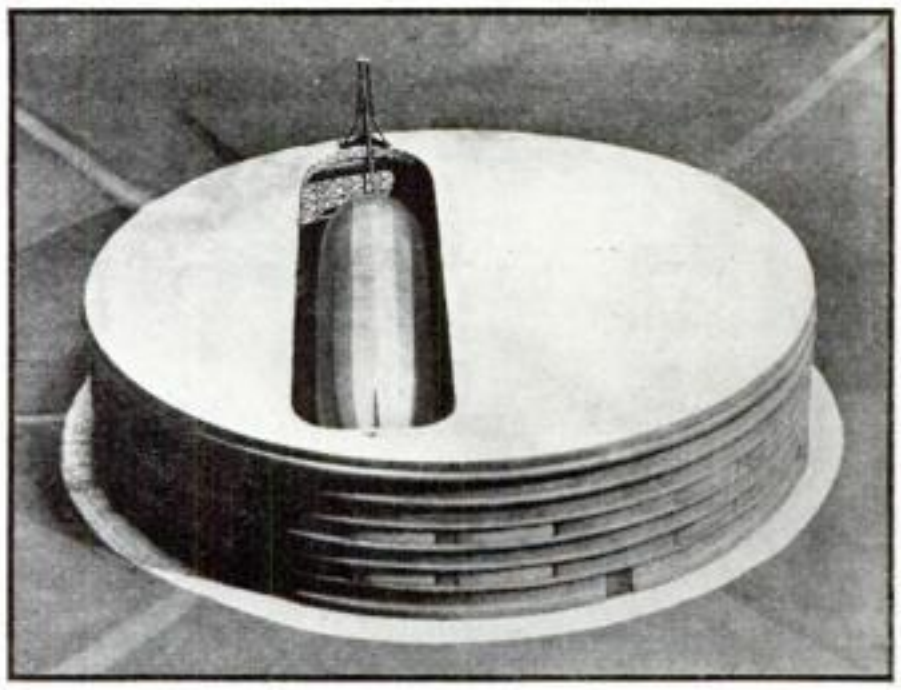
BAG ON WHEELS HOLDS SHOPPER'S PARCELS

WHEN the housewife has had a busy marketing day, a shopping bag on wheels eases the fatigue of taking the purchases home. The ingenious device illustrated here is the invention of a Viennese bootmaker, to assist his wife on her shopping tours. The bag proper is detachable and rests on a carriage so light that the whole contrivance may be lifted easily over curbs and rough spots in the road.

Shopping bag on wheels, at lower left, helps this Viennese housewife to carry home her parcels

NEW AIRSHIP HANGAR HAS DOOR IN ROOF

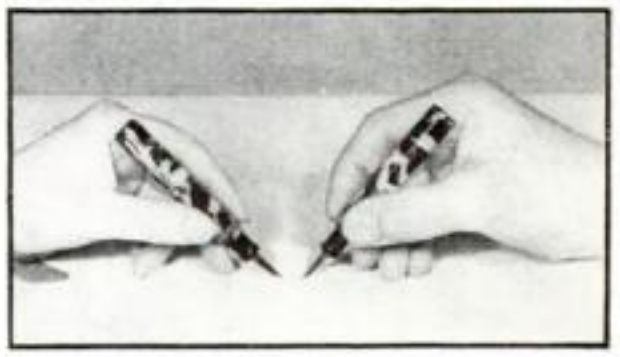
AIRSHIPS would leave and enter through the roof of a new, cake-shaped hangar proposed by a New York inventor. A horizontal doorway, a little longer and wider than the flying craft, is provided for the purpose. The entire roof revolves, so that an airship may leave or land facing the wind. According to the inventor, this allows a ship to leave its hangar regardless of wind direction. Only a fourth as many would be needed in the ground crew.



Coin-in-the-slot milk vender that will automatically make refund on returned bottles

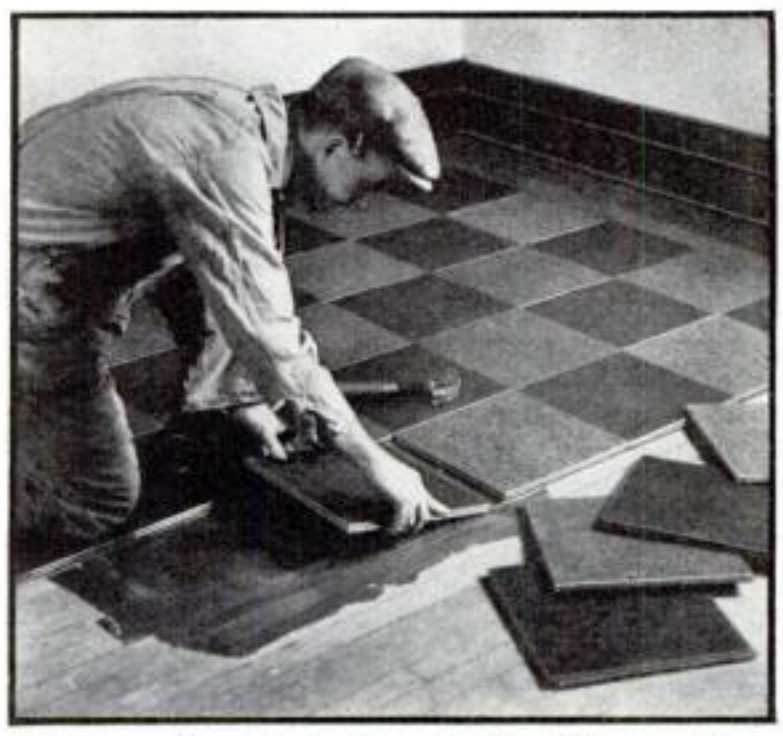
ROBOT PAYS FOR MILK BOTTLES

NOT only does the newest of sales robots deliver a bottle of electrically-cooled milk when a coin is dropped in the slot, but it also gives a refund for the return of the empty bottle. This cash is dropped in a receptacle at the lower right of the machine. The device is being installed in factory districts of a large eastern city, where it is proving a convenience to thirsty patrons.



FOUNTAIN PEN HOLDS BLACK AND RED INK

Two ink reservoirs in a new fountain pen enable it to write either in black or red or whatever other pair of colors the user may choose. The halves of this unusual writing instrument come readily apart, so that two persons may use it at the same time. Each color has its own writing point. When the halves are joined they fit easily in the pocket.



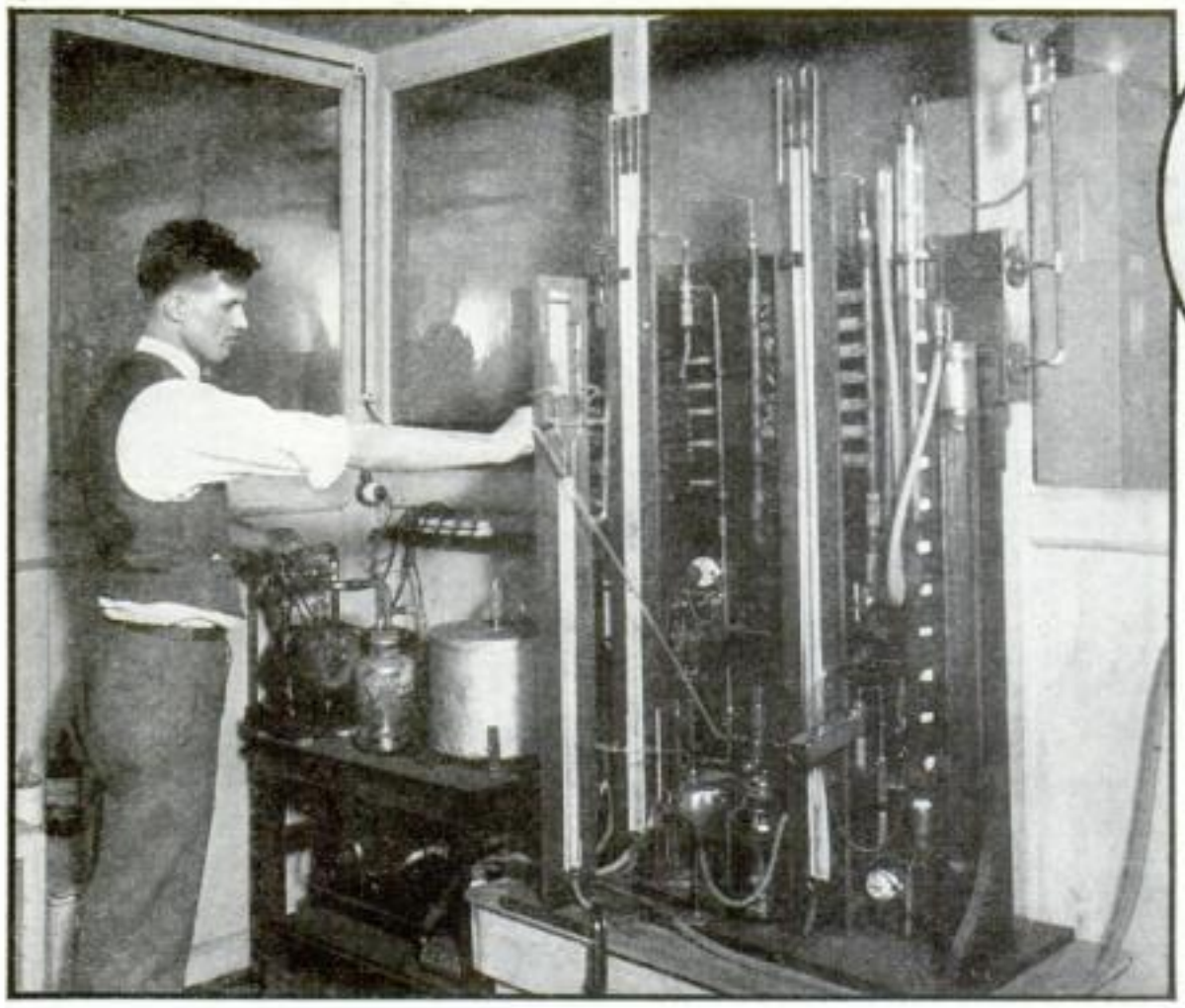
This new three-ply flooring material, which comes in two-color squares, can be laid on cement or wood base

FLOORING MATERIAL IN TWO-COLORED SQUARES

A NEW dress for the old floor comes in the form of squares, dark on one side and light on the other. When properly arranged they will give a surface of solid color or an unlimited number of attractive light-and-dark patterns. Tongue and groove construction is used for the joints. Outer surfaces of the three-ply blocks are of a wear-resisting, grainless wood composition, while the inner layer is of shock-absorbing and sound-deadening material. The material can be used as flooring or floor covering, and can be laid on either cement or wood and fastened in place by means of nails or glue.

Copyrighted material

IRRITANT IN GAS WAKES SLEEPER



Above, putting vile-smelling chemicals in gas; in oval, observers sniff the gases in test

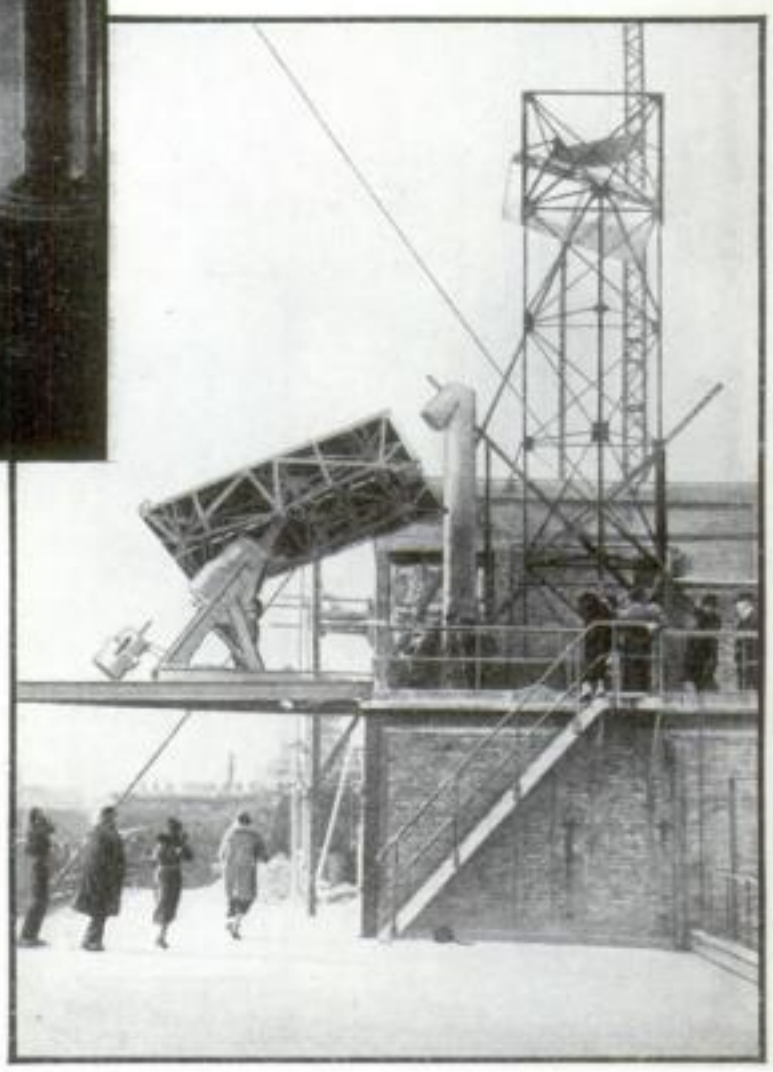
So THAT householders may be warned of escaping gas, ill-smelling or acrid chemicals are injected into the pipes in some sections of the country. Recently the U. S. Bureau of Mines and the American Gas Association tested ninety-three such agents to find the best. One of these proved to be ethyl mercaptan, a vile-smelling agent. For warning sleepers, however, the most dependable agents were those that irritated the nose and throat. In the tests, a measured volume of air was impregnated with the chemical agent under test and led into a chamber. Here observers stood in line waiting their turn to sniff and report on their reaction to the odor. The trials are expected to result in a standard practice that will reduce deaths occurring from gas asphyxiation.

THERMOMETER REGISTERS WORK ON SKYSCRAPER

On a Berlin skyscraper a giant thermometer checks the speed of erection. The lowest date, August 6, shows the day when work started, and the tempo of building has increased as one date after another was marked on the gage. The latest, Oct. 16, tells of the swift work that is throwing the building skyward.

MIRRORS THROW LIGHT INTO BUILDING

An ODD system of mirrors and tubes lights the interior of a newspaper building in Paris, France. The mirrors, atop the roof, catch sunlight and reflect it down pipes into the interior of the building. Here it falls upon pools of water that serve again as mirrors to scatter it about the rooms and halls.

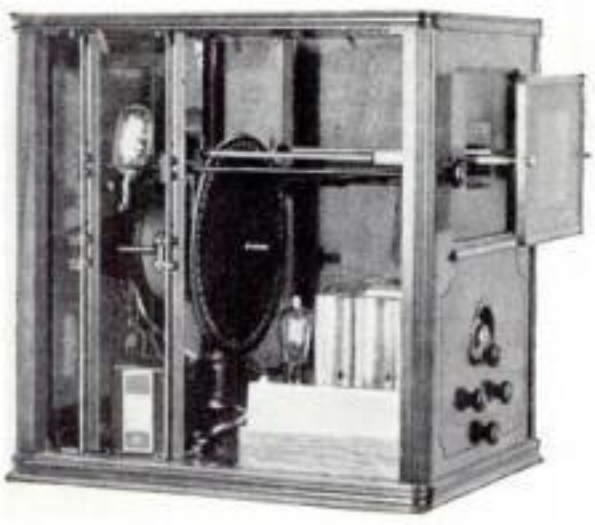


At right, mirrors on roof reflect sunlight down tubes. Above, the interior of building thus lighted

AMERICAN SICK ONCE A YEAR

Once a year, the average American becomes ill enough to stay home from his work and call for a doctor. This is revealed in figures compiled for the Committee on Costs of Medical Care. One or two illnesses a year are average for the American woman, they show, and an average child may be ill at least twice a year.

Copyrighted material



HOME RADIO SET GIVES SOUND AND SIGHT

RADIO programs may be seen and heard in the living room by the aid of a combination television and broadcast receiver that has just been placed on the market. A compact cabinet houses the entire apparatus. The television unit differs from the conventional type in that the image is seen upon a flat translucent screen, instead of through a magnifying lens, so that a group arranged in a quarter circle around the receiver may watch the scenes simultaneously without troublesome distortion. The sound-receiving section may be tuned either to the long waves of most broadcasting stations, like an ordinary radio receiving outfit, or to the short wave bands.

PYGMY IN JUNGLE HELPS MAKE TALKIE

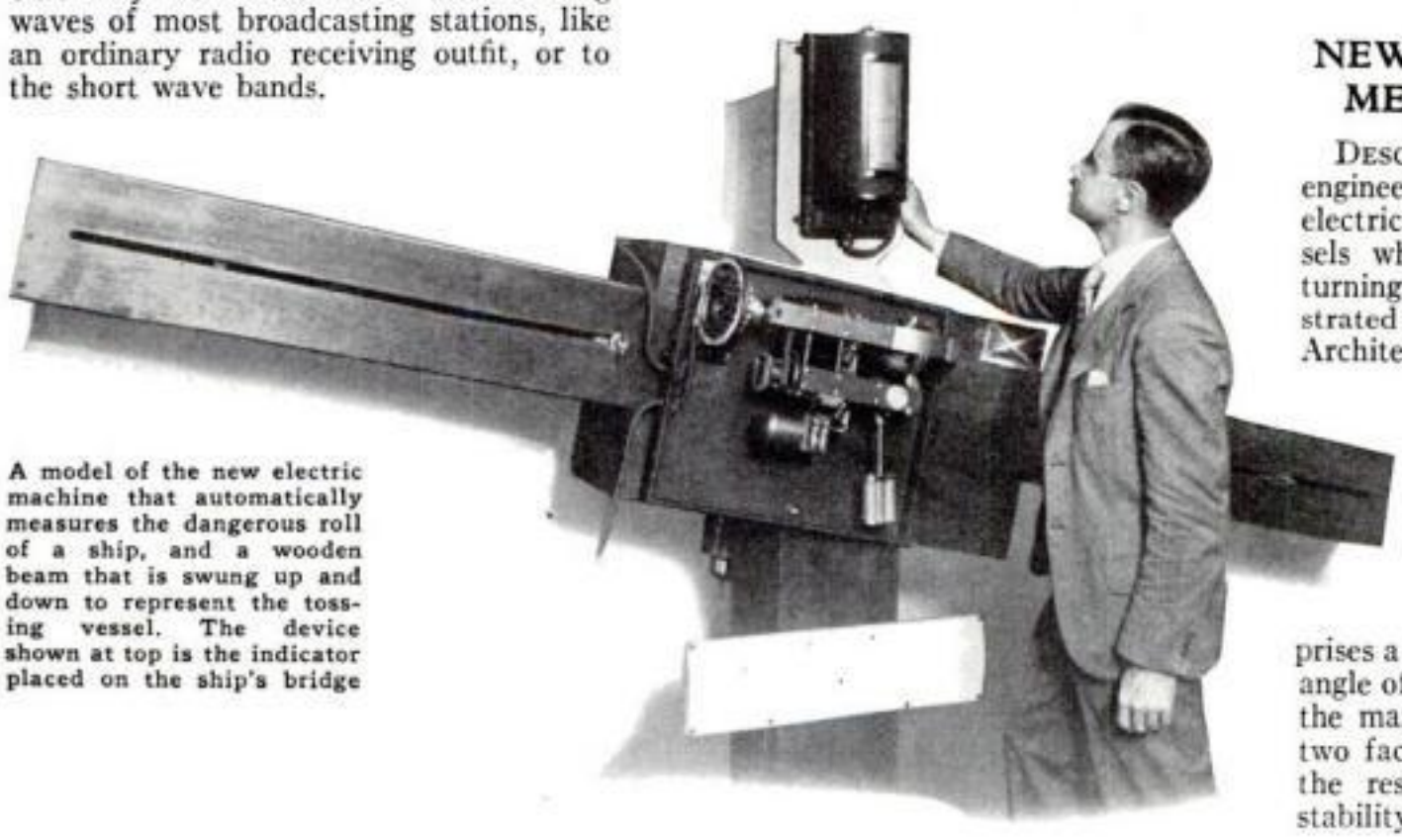
AN AFRICAN pygmy proved a willing and unusual subject for sound photography when the expedition of Martin Johnson, noted explorer, invaded the jungles of the Belgian Congo not long ago. Apparently unconcerned by the camera lens that stared at him and the tangle of wires and electrical equipment, the tattooed native of the Ituri forest threw out his chest and expressed himself fluently in his native tongue. The talkies are said to be the first made of the pygmy colony in the jungle.

A movie technician with his sound apparatus and an African pygmy of the Belgian Congo jungle of whom he made the first talkie film

TEST GLOBE-CIRCLERS' SPEED METER

A DEVICE that helped Wiley Post and Harold Gatty circle the world by plane in nine days may be adopted by Army and Navy flyers as a result of tests now being made in Washington. This "ground speed meter" tells the pilot how fast he is traveling with respect to the earth. Devised by Gatty, it is ingeniously simple. The user sights at the earth through a continuous belt of cross-lined transparent film, kept moving by clockwork at a uniform and controllable rate. By adjusting the speed of the film until ground and film are passing beneath the observer's eye at the same rate, a ground speed reading is obtained, accurate to within a few tenths of one percent.

Harold Gatty's ground speed meter, through which the observer sights at the earth and gets plane's actual forward velocity



A model of the new electric machine that automatically measures the dangerous roll of a ship, and a wooden beam that is swung up and down to represent the tossing vessel. The device shown at top is the indicator placed on the ship's bridge

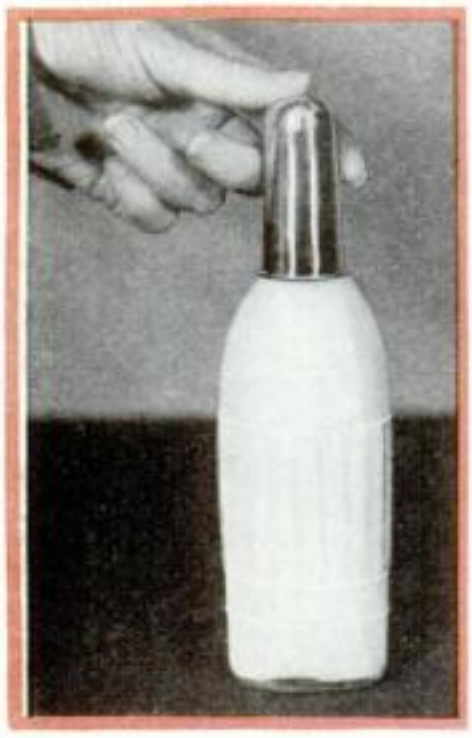
NEW ELECTRIC MACHINE MEASURES SHIP'S ROLL

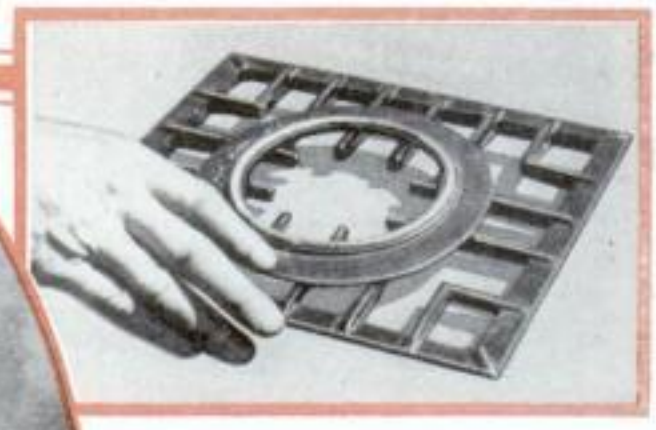
DESCRIBED as revolutionary by marine engineers who watched it work, a new electric device to warn captains of vessels when their ships are in danger of turning over at sea was recently demonstrated at the Webb Institute of Naval Architecture, in New York City. Had the ill-fated *Vestris* been equipped with this device, it was said, the vessel would never have been lost. The device automatically computes the ship's "metacentric height," a measure of its stability, from moment to moment. It comprises a pendulum to register the maximum angle of roll, and a gyroscope to determine the maximum velocity of the roll. These two factors are combined electrically and the resulting figure, showing the ship's stability, is shown on the vessel's bridge.

Copyrighted material

· New Inventions *that* Take

GUARD BABY'S BOTTLE. Below, an aluminum cover that can be slipped over the nipple on baby's bottle to keep it sanitary





PROTECTS GAS BURNER. Vessels boiling over sometimes extinguish gas flames without checking the flow of gas. To prevent this a gas grate has been designed that drains overflowing liquid away and thus guards the flame

IT WATCHES YOUR EGGS. There is no danger of over-cooking your morning eggs if this easily set alarm clock is used. The pointer can be set at any desired interval from a minute up, and the alarm tells you when the food is properly cooked

HITCH ON A MOTOR. A tiny motor that can be connected with your sewing machine to run it with no effort on your part is now available. It plugs into any light socket and is quickly converted by attachments into a silver polisher, cream whipper, or household fan

WATER POWER IN KITCHEN. This attachment, connected with a faucet, becomes water power mixer and can be used to beat eggs, whip cream, mix malted milk drinks, or stir lemonade. It is operated by a water motor installed in the top

HOLD THAT JAR. Fitting the top on a fruit jar so tightly as to keep the air out can be done with the aid of two grips, one of which holds the jar and the other turns down the top. The jar can't slip and spill the contents and there is no bruising of the hands. The grips can also be used to reverse the operation

STRAINER SAUCEPAN. Recently there was exhibited in England a novel saucepan that had attached to it not only the lid with lifting handle, but also a strainer with handle. These attachments make it possible to drain liquid from pan without burning your hands

A PRACTICAL FENDER. For the fireplace a fender has just been invented that has a practical use. Opening it to its greatest length reveals a clothes drier that is two and a half feet high when extended and which is held solidly in place by clips

Copyrighted material

Drudgery *out of* Housework

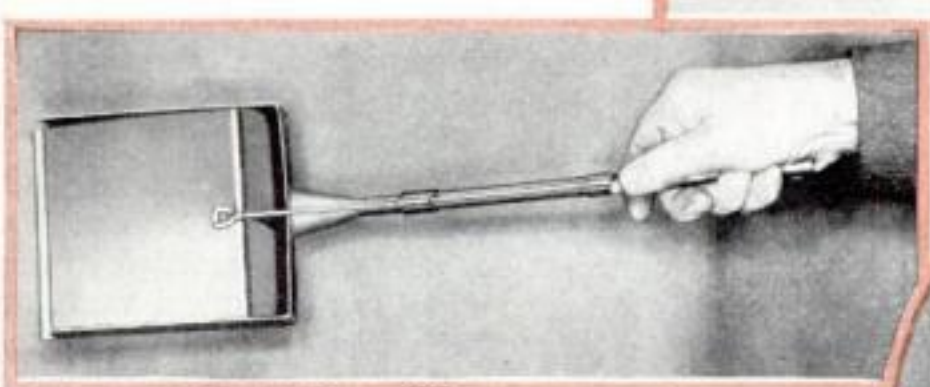
TWO AUTOMATIC TEAPOTS. At right, copper kettle, teapot, clock, and gas burner that automatically will make your tea. Above is a similar teapot, lacking the clock and electrically heated. In each the gas or current is automatically turned off. Water is placed in kettle, tea leaves in pot, and when water boils it is forced up spout into the teapot. Bell in clock or snap of switch warns tea is ready

USE NO HOOKS. Towels are not torn when this holder is used. It consists of a hollow metal ball with hole and washer that holds towel fast

WATERLESS COOKING DISH. An improved model of a familiar and useful utensil is this capacious self-basting roaster, which requires no addition of water. The lid is designed to retain natural juices and to make it unnecessary to mind the roast as it cooks

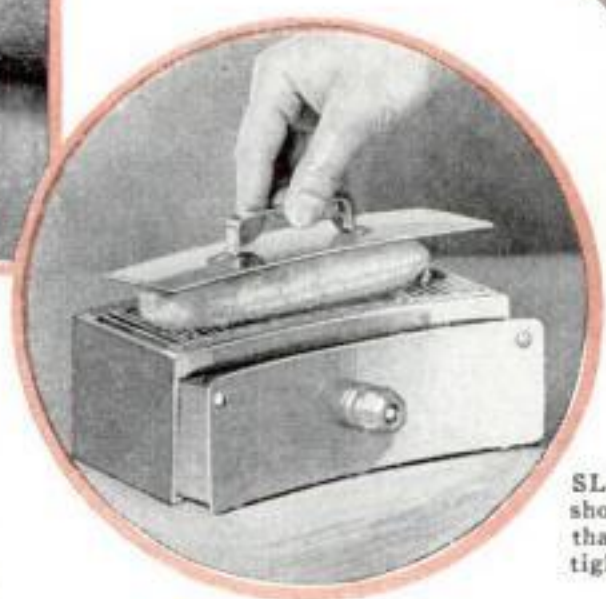
RACK IS A DUSTPAN. At right is a broom holding rack that attaches to the wall. Removing the broom, the rack is found to be a convenient dustpan with handle, as shown below. It is made of durable metal designed for long and rough usage

LAMP IS A CLOCK. Built into the base of this lamp is a clock with a luminous face that can be read in the dark. It has an alarm attachment and is connected with circuit that keeps it running when lamp is turned off in the daytime



HANDLE ON POT LID. This handle, attached to a pot lid, is expected to save the hands from burns and hold lid in place

HOLDS ASH DUST. This shovel, two views of which are shown at left and above, has a lid that opens as it is shoved into furnace, but which becomes a tight hood when the shovel is withdrawn, thus preventing the escape of the dust that ordinarily fills furnace room



SLICER WORKS FAST. At left is shown a fruit and vegetable slicer that cuts many slices at once. Thin tight wires are forced through fruit

Copyrighted material

POPULAR SCIENCE
MONTHLY

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
SYDNEY OXBERRY, Art Editor

Published Monthly by Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York City. Single Copies Twenty-five Cents. In United States and Possessions, $2.50 the Year. In All Other Countries, including Canada, $3.00 the Year.

Thomas Alva Edison

A THOUSAND years from now, when the names of the greatest statesmen, financiers, philanthropists, gangsters, and others now before the public eye will have sunk into oblivion, the name of Thomas Alva Edison probably will be nearly as well known as it is today.

Yet when you come to analyze the inventions bearing Edison's name, it is impossible to pick out even one that would warrant blazing his name down through the centuries as one of the greatest, if not the greatest, inventor the world has ever seen.

The invention of the electric light, usually considered Edison's greatest achievement, and the peg on which most of his fame has been hung, was really of trifling importance compared with his marvelous work in bringing about the general use of electric lighting. If Edison had never lived, the electric light in physically practical form probably would have been produced within a few years of the same period in the world's history. Other men, notably Swan of England, were within hailing distance of the goal when Edison reached it.

However, without Edison's extraordinary ability first to visualize and then to carry to realization the practical application of an invention, it is safe to say that electric lighting would, today, be in its infancy.

He not only took other people's theories and carried them through to a practical electric light, but he also took the known facts about electricity and developed them into a complete system of electric lighting.

Michael Faraday, for example, worked out the theories of the electric generator before Edison was born, yet it remained for Edison to take these theories, mix them with liberal portions of mechanical vision and hard common sense, and produce the Edison dynamo.

Thomas A. Edison was not, in the strict manner of speaking, a true scientist. He was never concerned with scientific problems as such. He was interested only in practical applications, the things you can see and touch and watch while they are working.

Not a Mathematician

HE WAS not a mathematician. It is quite probable that Einstein's theories were nearly as incomprehensible to him as they are to almost everybody else, since he received little schooling and virtually no formal scientific training.

Edison's active career as an inventor covered over forty years. His earliest invention, made in 1868, was an electrical vote recorder; and with $40,000 he received in 1870 for stock ticker and other inventions he started a factory. During the following year he assisted Sholes perfect the typewriter. For the next few years he was occupied with inventing and perfecting duplex, quadruplex, multiplex, and other telegraphic apparatus.

Between 1875 and the early 1880's he worked out the carbon telephone transmitter, the phonograph, and electric lighting. In 1883 he discovered the so-called "Edison effect"; that is, the flow of electrons in a vacuum when electrical pressure is applied.

It will, perhaps, be a comfort to struggling young inventors to realize that even the great Edison was not infallible. Electromagnetic waves, a phenomenon of which Edison was of course aware, and the Edison effect together constitute the vital principle on which all modern radio is founded, yet radio was developed not by Edison, but by others.

Edison devoted the early nineties to perfecting the motion picture camera, which has completely revolutionized all our ideas of entertainment. The years 1900 to 1910 he applied, in the main, to the invention and perfection of the Edison alkaline-type storage battery, paying some attention, however, to improvements in the making of concrete. Manufacturers in this line assert his accomplishments were extremely valuable.

His Search for Native Rubber

DURING his later years the great inventor devoted much of his time to the development of new sources of rubber from plants capable of being grown in temperate climates.

It has been said that Edison was only a figurehead, that he hired other people to invent things and then claimed them as his own. It is true, of course, that Edison had assistants. No human being, not even Edison, could single-handedly have perfected every trifling detail in the list of over a thousand inventions that bear Edison's name.

But if Edison handed one of his assistants a roughly penciled sketch embodying the principle of a new idea and the assistant worked it out, who is entitled to the credit, the assistant who did the mechanical work or the genius who originated the idea?

Those who worked for Edison long enough to know the man testify that he always led, they followed—and those who could not stand Edison's daily stint of eighteen hours a day soon fell by the wayside.

There have been greater electrical geniuses than Edison, greater mechanical experts, greater chemists, perhaps more lovable characters, but for a combination of all of these qualities in one man, the world has for half a century given the palm to Thomas A. Edison.

Copyrighted material

You Can Talk Around the World

By JOHN CARR

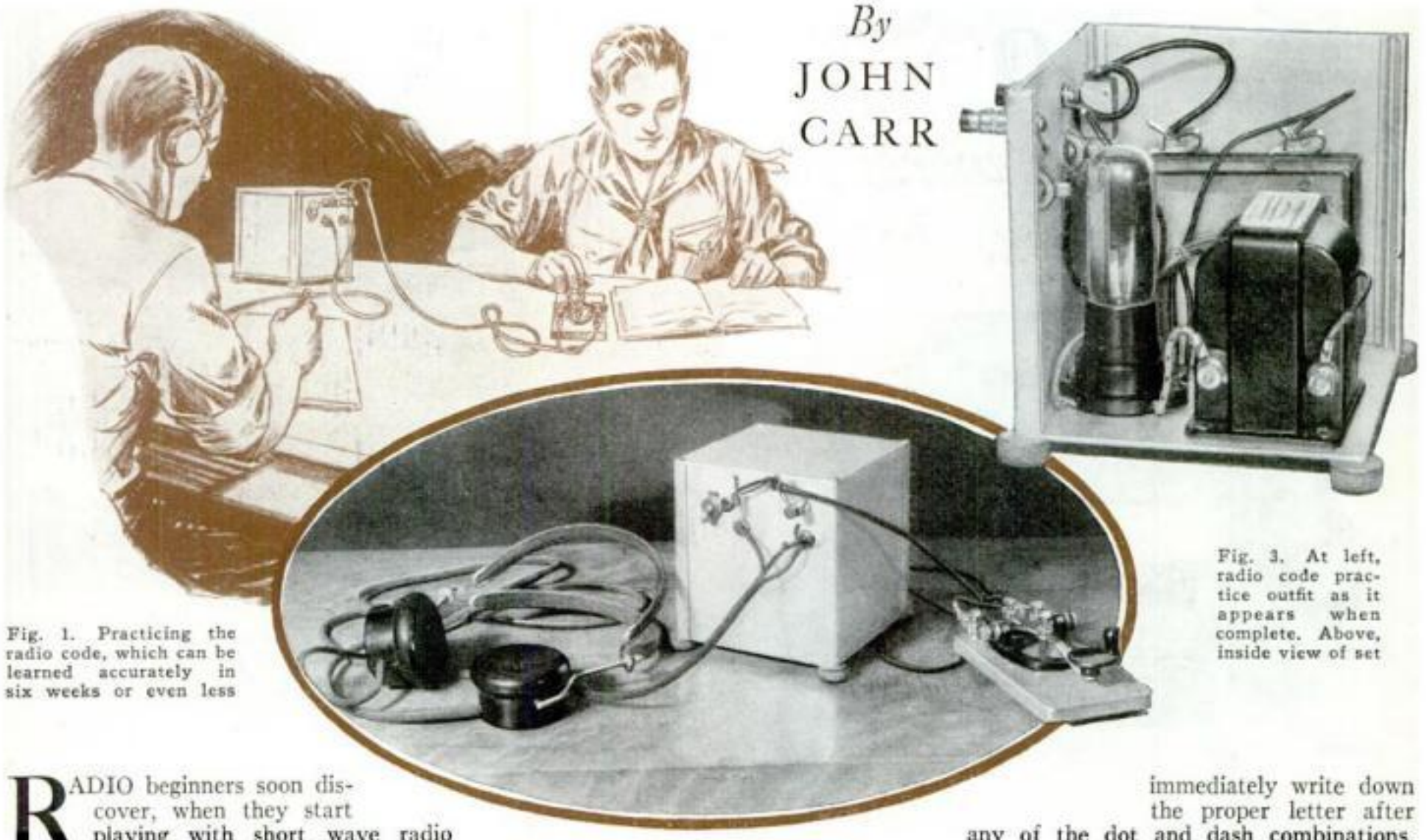


Fig. 1. Practicing the radio code, which can be learned accurately in six weeks or even less

Fig. 3. At left, radio code practice outfit as it appears when complete. Above, inside view of set

RADIO beginners soon discover, when they start playing with short wave radio reception, that these higher frequencies carry a lot of radio transmission in addition to the short wave broadcasting. There are, for example, some 18,000 regularly licensed amateur radio stations working on these short waves i. this country alone, and many thousands more scattered all over the civilized portions of the earth.

Furthermore, the foreign radio amateur stations are much more easily received in this country than the foreign short wave broadcasting. Most of this amateur transmission is in the dot-dash code and is therefore meaningless until you learn how to receive the radio code. Bill Smith, located only a few blocks from you, may be having a pleasant chat with a fellow radio amateur in England, Australia, or South America, but you won't get any thrill out of that fact until you can follow both ends of the conversation.

Even if you never intend to join the ranks of transmitting amateurs with a station of your own, a knowledge of the radio code will enormously increase your pleasure in short wave radio reception.

The little table in the center column will give you the dot-dash equivalent of the alphabet in International Morse Code, now almost universally used for all radio transmission. Note that the letters have not been given in alphabetical order, but are grouped in a way that will make memorizing extremely easy.

The first job, of course, is to memorize this code so thoroughly that you can write after any letter its code equivalent without having to stop and think for even a second. The next is to learn the code the other way around, too, so that you can immediately write down the proper letter after any of the dot and dash combinations.

After this preliminary memorization, you can proceed to actual code practice. It will be a big help if you can arrange to practice with some friend of yours who is also just learning the code.

E	·	N	−·	G	−−·
I	··	D	−··	W	·−−
S	···	B	−···	1	·−−−−
H	····	R	·−·	2	··−−−
T	−	K	−·−	3	···−−−
M	−−	Q	−−·−	4	····−
O	−−−	Y	−·−−	5	·····
A	·−	L	·−··	6	−····
U	··−	F	··−·	7	−−···
V	···−	C	−·−·	8	−−−··
P	·−−·	J	·−−−	9	−−−−·
X	−··−	Z	−−··	0	−−−−−

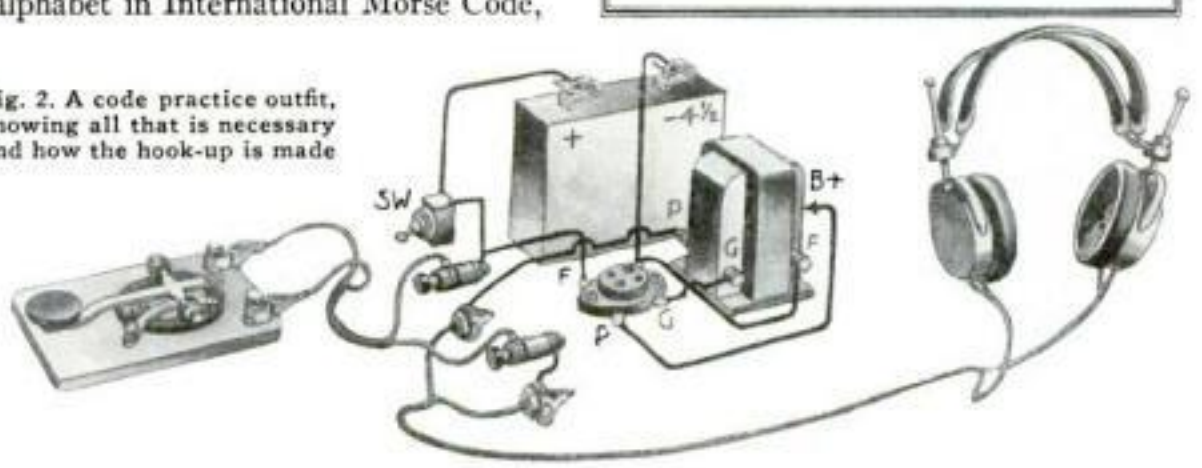


Fig. 2. A code practice outfit, showing all that is necessary and how the hook-up is made

THE simplest outfit for code practice is a telegraph key, a buzzer, a battery, and a pair of headphones. This outfit is not, however, ideal for the job. In the first place the noise of the buzzer probably will annoy other people. Second, the ordinary house buzzer has a low rasping note not at all like the radio signal you are practicing to understand.

Figures 2 and 3 show a code practice outfit that has none of these disadvantages. It makes no noise perceptible to anyone in the room except the fellow wearing the headphones, and it produces a whistling signal that is an exact duplicate of the real signals you hear over the air. Any number of pairs of headphones can be connected in parallel, so that a whole roomful of students can benefit from the same transmission.

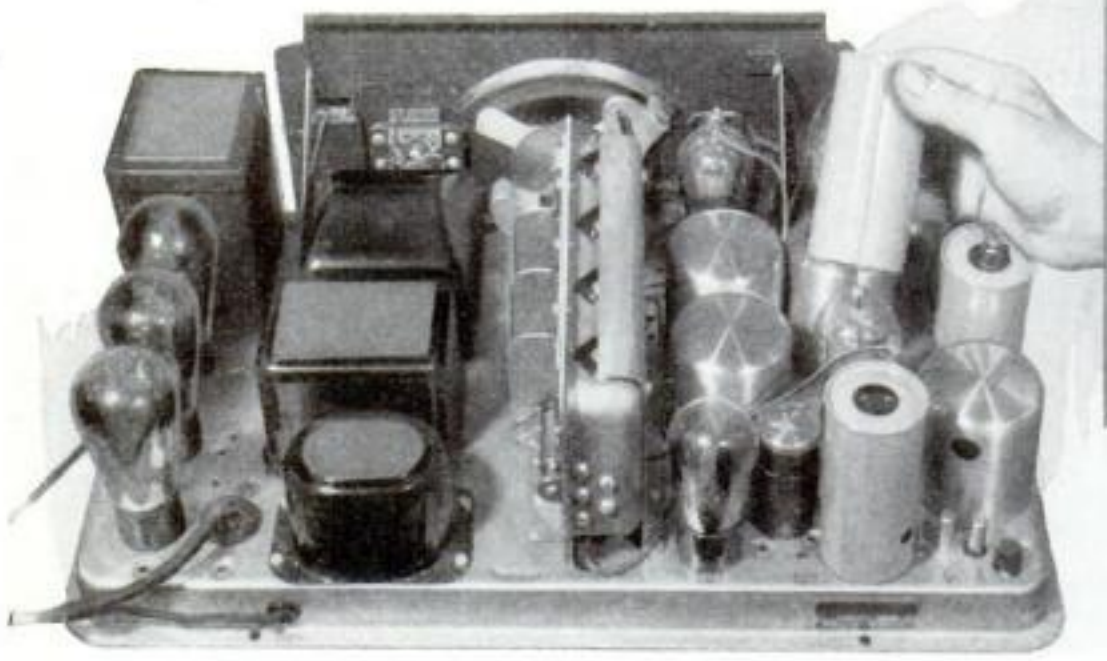
To build this code practice outfit, which is really nothing more than a greatly simplified audio oscillator, you need a key, an X type radio tube socket, an audio transformer, a switch, four binding posts or pin jacks, and a pair of headphones. Of course a much neater outfit will result if the apparatus is built into a small aluminum box shield as shown, but it will work just as well if fastened, in almost any arrangement, to a small board.

A type 199 battery tube should be placed in the socket. Note that no rheostat control is required. That is because the plate circuit of the tube is operated at only the voltage of the C battery, and heating the *(Continued on page 111)*

Copyrighted material

TODAY'S Radio Sets

are made worse to make them better



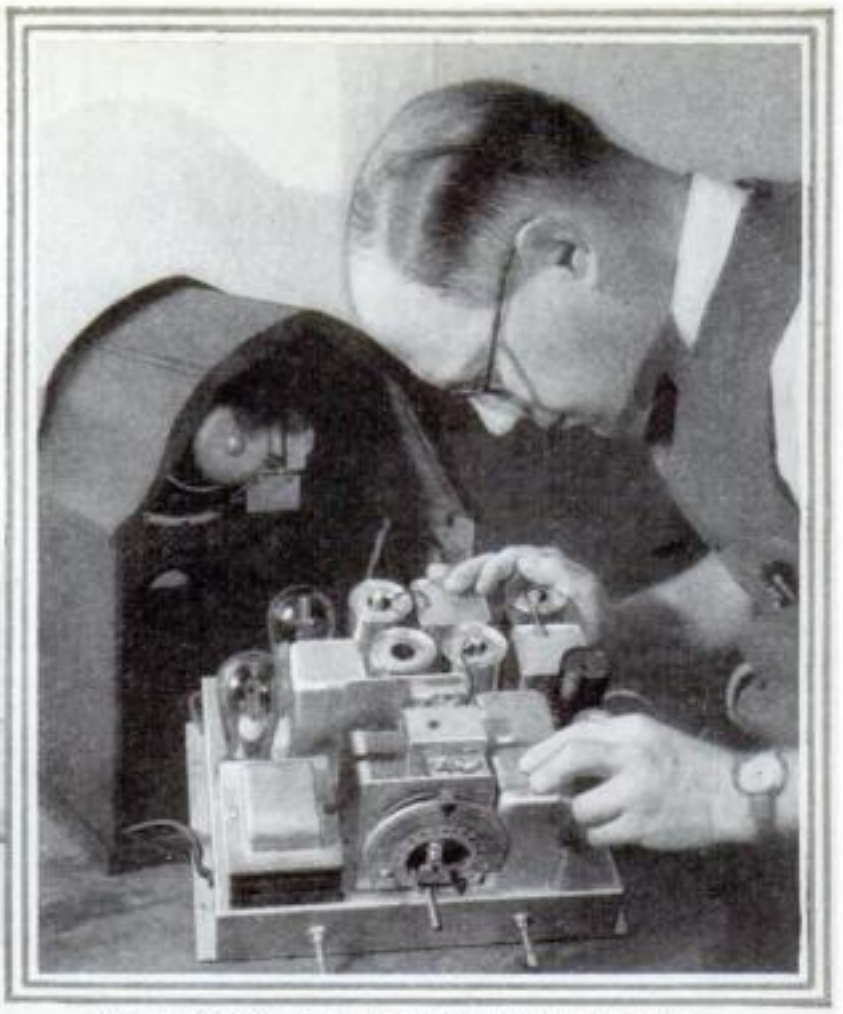


Fig. 1. Above, left hand rests on tuned stages without tubes, used to maintain selectivity. At left, extra tubes added to basic circuit as radio-frequency amplifiers preceding first detector

By ALFRED P. LANE

IMPROVING radio reception by making radio sets worse is the latest paradoxical development in the realm of broadcasting. According to old-fashioned standards, the average good radio of today is anywhere from two to five times less sensitive than those of previous seasons.

In the radio laboratory of the Popular Science Institute, last year's high grade sets showed a sensitivity of between one and two microvolts per meter. The latest receivers are showing a sensitivity of only about five microvolts per meter. This means that under theoretically perfect conditions, a distant station would have to produce a signal two to five times as loud in order to be heard on a modern set.

What seems to be progress in the wrong direction actually results in improved reception. Although the new sets are not so sensitive, they will, under practical conditions, enable you to log more distant stations than you ever heard before.

The point, is, of course, that absolute sensitivity, as measured under theoretically perfect conditions, is only one of the qualities that determines a radio receiver's distance-getting ability. Under practical conditions, where hundreds of stations are treading on each others heels all up and down the dial, selectivity is of paramount importance. Furthermore, selectivity definitely cuts down the amount of noise through which you must identify the call letters of the distant station and enjoy its program.

The improvements that have led to the increased selectivity of the latest superheterodyne circuits was discussed several months ago (P.S.M., Oct. '31, p. 71). In that article it was stated that the effective sensitivity of the latest sets was improved. However, radio fans may find it difficult to understand how a theoretically more sensitive set can actually be less sensitive than another receiver with a lower theoretical rating, when both are tested under practical conditions.

Suppose, for example, that you are attempting to bring in a station 1,000 miles or more away. If the station you wanted were the only one on the air and there were no such thing as static, obviously the sensitiveness of the receiver would be the governing factor. But static is never absent, and a reference to the list of stations now operating on this continent will show you that there is not a station that is separated from any other station by more than ten kilocycles on either side.

The sensitivity of a receiver determines just how loudly a wanted station will be received, but the selectivity governs the loudness of the stations on adjacent wave lengths that you do not want. Also, selectivity determines the amount of static noise.

Static exists on all wave lengths, and in spite of the claims of manufacturers of worthless static suppressing devices, there is no known way to decrease the static on any wave length without cutting down the strength of the broadcasting on that wave in exactly the same proportion.

EXTREME selectivity in a radio receiver does not eliminate the static on the wave to which it is tuned. It does cut out the adjacent wave lengths with their loads of static, and the practical result, as registered by your loudspeaker, is less noise to spoil the reception you want.

You can hear a whisper in a quiet room, but you can't understand someone shouting at you in a howling storm. In the same way you can plainly hear a distant station coming in at a low volume level if most of the extraneous noise and interference is cut out.

Many radio fans, familiar with the need for increased selectivity, have wondered what has become of the loop antenna, once considered a great aid to selectivity. Radio receivers are no longer fitted with the loop antenna because its disadvantages more than counterbalance its directional selectivity.

THE engineers of the Popular Science Institute have suggested for years that to get the best radio reception you must use a good antenna. This advice applies more than ever before to the newest radio receivers. In fact, the ma.velous selectivity of the modern set greatly increases the advantages of the really adequate antenna. In the days when even the best set was none too selective, the use of a short antenna was often warranted because it tended to eliminate an unwanted station.

Then, too, in those days fewer stations were operating, there were no super-power stations, and man-made static—that is, interference caused by near-by electrical apparatus—was almost negligible. Broadcasting stations in recent years have increased their power enormously, and the number of electrical appliances in use has grown to an astounding total. Some of these cannot cause radio interference, but the man-made static produced by the others now adds appreciably to the general noise level.

Aside from its directional properties, the loop antenna, like any other short antenna, picks up an undue amount of

Copyrighted material

Receivers Less Sensitive *than* Formerly Reduce Static *and* Bring in Many Distant Stations

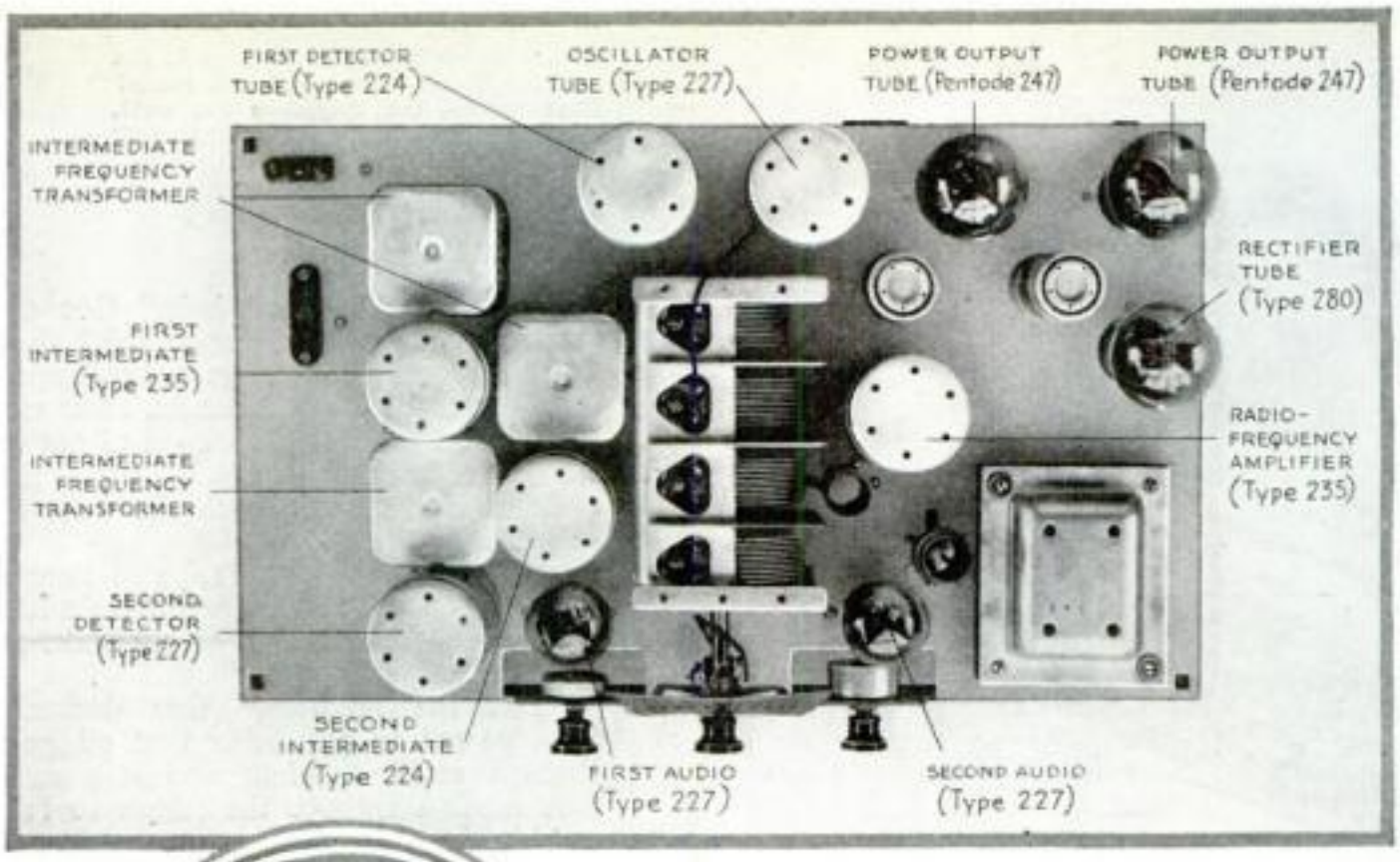


Fig. 3. At left, an elaborate modern set, using many tubes. Diagram shows tubes and their uses in a circuit of great selectivity

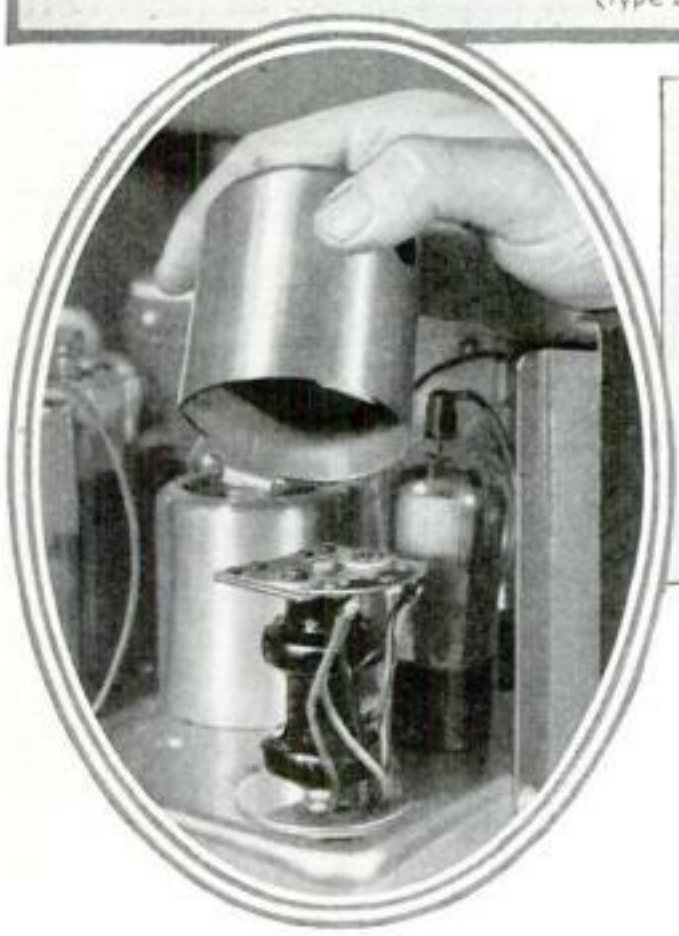


Fig. 2. The latest type of intermediate frequency transformer used in the superheterodyne

Fig. 4. Drawing illustrates the proper use of antenna and the manner in which static is reduced in the same set when an adequate aerial has been connected with receiver

static in proportion to the strength of broadcast signals.

The way to overcome the local interference caused by the miscellaneous electrical machinery in the neighborhood is to put up an antenna that will bring in the broadcast signal with considerable strength. Reduction of the sensitivity of the receiver will bring about a corresponding reduction in local interference.

THE drawing in Fig. 4 graphically shows effect of different lengths of antenna on the relative strength of the broadcasting and the local interferences. At the left, below the very short antenna, are two wavy lines indicating the radio-frequency oscillations from a broadcast station and from the man-made static.

Note how, when the receiver is made sensitive enough to get an adequate signal from the broadcasting station, the static reception is much too strong for satisfactory results.

In the middle drawing, the longer antenna brings in the wave from the desired station so strong that the volume control can be turned down to the point where the noise level is materially less. At the right you see the value of a full sized antenna. The local noise level has shrunk to negligible proportions.

An ideal antenna for use with a modern set should be from seventy-five to one hundred feet long and as high as possible. Obviously local conditions often make such an antenna a physical impossibility. In such cases, the radio fan will have to get along with a shorter installation.

Ideal radio broadcast reception should have no background of miscellaneous noises. In other words, when the music or speech stops, there should be no trace of sound until the program continues. The modern trend to super-power stations is a step in the right direction because the stronger the signal, the lower will be the level of the background noises.

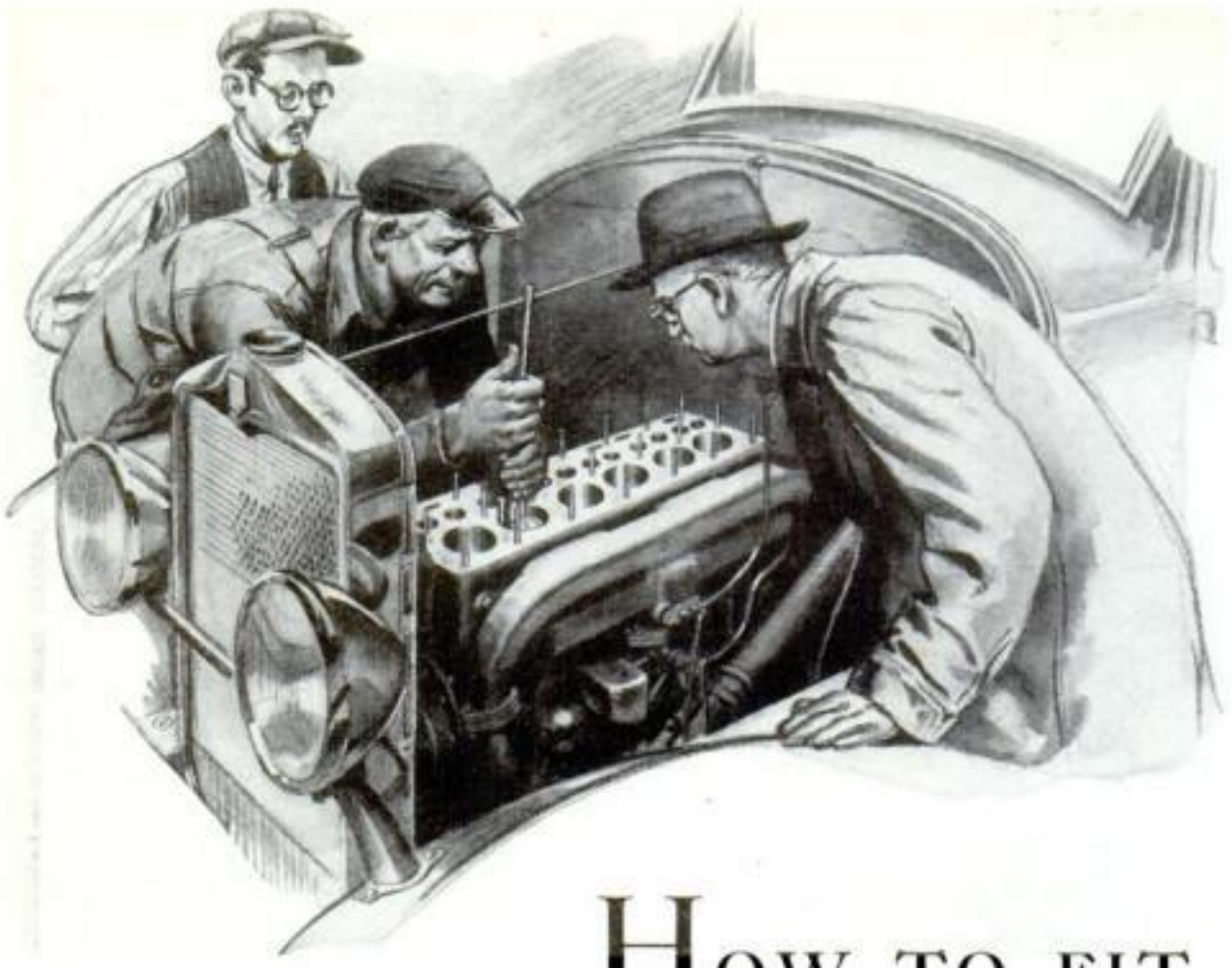
Another reason for the use of an adequate antenna is that it will enable you to reduce the self-generated noises in your receiver. The tubes themselves produce a certain amount of hissing due to the peculiarities of electronic action. All tubes produce these hissing effects, but the only ones you hear in the loudspeaker are those in the circuit ahead of the audio amplifier stages. A good antenna permits you to reduce the sensitivity of the receiver by turning down the volume control, with consequent reduction of the tube noises.

Many prospective radio set buyers are bewildered by the differing numbers of tubes in various radio receivers. They want to know what effect the number of tubes has on sensitivity and selectivity. Before the coming of the superheterodyne, such a question was easily answered. In tuned radio-frequency sets of conventional design, both selectivity and sensitivity frequently depended on the number of tubes in the circuit. This does not hold good for the superheterodyne. There is relatively little difference in either the sensitivity or the selectivity of superheterodynes no matter how many tubes are used in the circuit.

THE lowest number of tubes a set may have and still be a true superheterodyne is five, counting the rectifier. There must be a first detector tube, which, in the simpler arrangements, also is the oscillator, thus performing a double function. Then there must be at least one tube acting as an intermediate amplifier. After that there has to be a second detector tube and at least one audio amplifier tube such as the power pentode.

By running the signal through a couple of tuned stages not using tubes, adequate selectivity can be maintained. The loss in signal strength in the untuned stages can be made up to a large extent by operating the intermediate amplifier at maximum efficiency. Of course, you can't get something for nothing, and in the smallest outfits the tone quality is not up to that produced by the more elaborate receivers using ten or more tubes.

Copyrighted material



Gus, with a dial indicator gage in the cylinder, said: "See what that reads? That means the cylinders are oval, not round as when the car was new"

How to Fit New Piston Rings

By MARTIN BUNN

"I'M ALL through trying to repair automobiles," said Mr. Penny disgustedly as Joe Clark swung open the door of the Model Garage and his partner, Gus Wilson, smiled a greeting.

"Last job didn't turn out so good, eh?" suggested Gus.

"To tell the truth, Gus," confessed Penny, removing his hat and absent-mindedly scratching the top of his bald dome, "as an auto mechanic I fear I'm a good schoolmaster."

Penny spent his days pounding history into boys and girls at the local high school.

"I thought I'd economize by doing my own repair work," he went on. "The motor seemed to be getting weaker and weaker and it used a tremendous quantity of oil, besides starting hard and continually fouling spark plugs. I'd read somewhere that those symptoms meant that the piston rings were worn out."

"You put your finger on the trouble, at any rate," Gus interrupted encouragingly. "Then what did you do?"

"I suppose I should have come to you for new rings," said Penny, "but a doctor's bill came in that week and I thought I could save a little by getting the rings from a cut-rate mail order house. It took them four days to get here and then it took me all day Saturday and Sunday and all my spare time for the better part of a week to install them. And now it's worse in every way than it was before! What did I do wrong?"

"I can make a durn good guess," Gus grinned, "but guessing is bum business in the auto game. Stop around after school tomorrow and I'll have her opened up so we can find out what's wrong."

When Penny arrived a few minutes after three the next day, Gus took him over to the corner where his car was parked. The cylinder head had been removed, the oil pan was off, and two of the pistons lay on a bench near-by.

"Now," said Gus as he picked up a cylinder bore gage of the dial indicator type, "watch this and see what happens."

He carefully started it down the bore of one of the cylinders from which the piston had been removed. The threadlike hand of the dial indicator spun round and then trembled back and forth within a narrow space on the dial as the gage moved the last inch to the halfway mark.

"See where the hand stands now?" he said, and then he turned the gage around about ninety degrees so that it measured the bore cross-wise instead of from front to back. "Now see what it reads," he said as the needle swung around over five divisions.

"What does it mean?" Penny asked, frankly puzzled.

"It means that the cylinders are worn oval instead of being true round as they were when the car was new.

"Everybody knows you can't put a square peg in a round hole," Gus explained, "but lots of motorists think they can put round piston rings in egg-shaped cylinders and get good results. How can piston rings prevent the escape of gas or the flow of too much oil to the top of the cylinder if the rings touch the walls at only two or three spots?"

"It's obvious they can't," said Penny. "Still I shouldn't think a few thousandths of an inch out of round would make as much difference as that."

"You bet it does," Gus declared. "You've got to remember that oil goes through small openings and it doesn't take much oil above the piston to foul spark plugs and cause a lot of carbon and other trouble. Every bit of gasoline vapor that shoots past the loose rings means that much lost power. You actually could hear it hissing by in these cylinders on the compression stroke when I cranked it by hand."

"And I suppose the cheap rings just made it worse," Penny sighed.

"The rings made it worse, yes," Gus replied, "but not because they were poor quality rings. They are good rings, but not for these pistons. They fit much too loose in the ring slots. There's not much good in having rings that fit the cylinder walls all the way round if they don't also make a good fit in the slots. If you can wobble 'em up and down in the slots, lots of gas will sneak past by going behind in the slots."

"Anything else the matter?" Penny asked. "I noticed myself that the pistons seemed to be a pretty loose fit in the cylinders. Are they worn out, too?"

"Pistons," Gus explained, "are not supposed to fit tight. If you put a set of pistons in a car that were just enough smaller than the bore of the cylinders to slide up and down easily when oiled, they'd expand and stick tight as soon as the motor warmed up."

"Why should the piston expand any more than the cylinder?" Penny asked. "They both get hot, don't they?"

"Sure," said Gus, "but the piston gets hotter—it isn't water-cooled and the cylinder is. Furthermore, the top of the piston, the piston head, gets hotter than the bottom edge or skirt. The usual practice is to make pistons tapering, with a lot more clearance at the head than at the skirt. Most of 'em are made with about ten times more clearance at the top than at the bottom. *(Continued on page 117)*

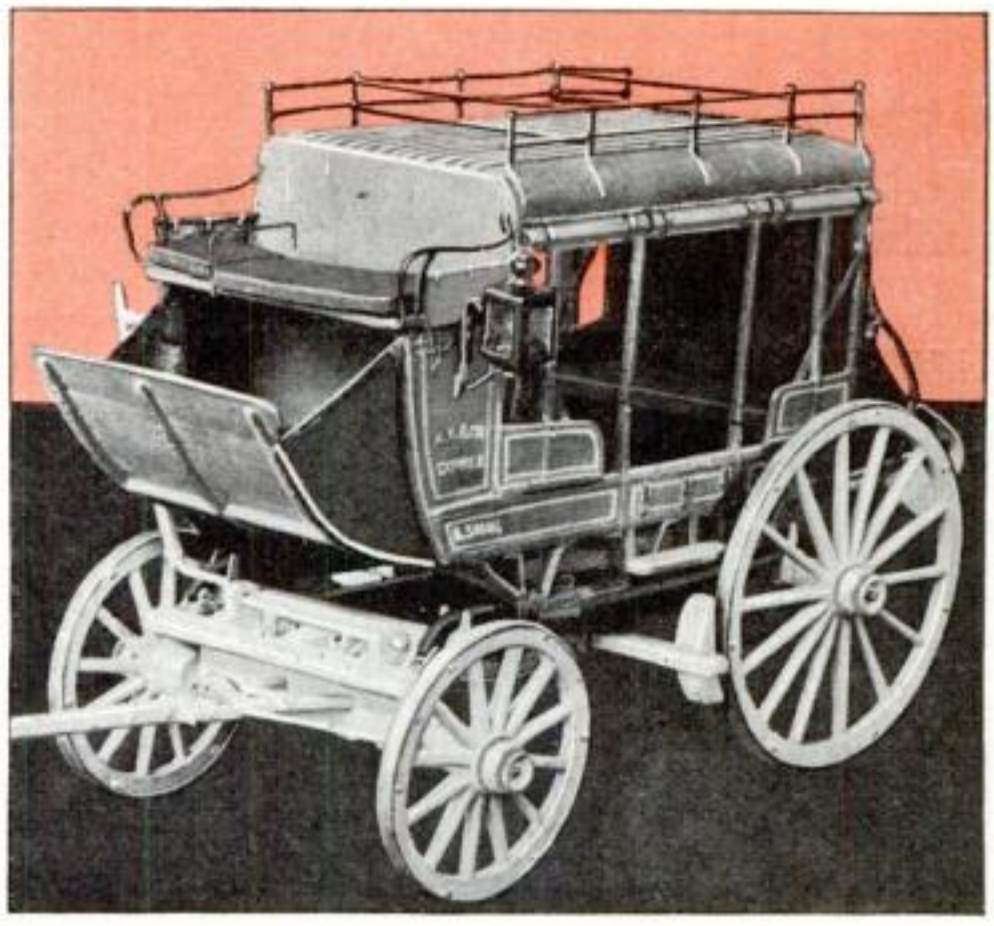
GUS *says* . . . **Remember that every time you put on the brake, you do what practically amounts to squirting a couple of drops of gasoline on the road. It takes the energy of burning gasoline to give your car its forward speed and, by rights, this forward speed ought to be used to move the car ahead. The brakes are nothing but energy converters. They change the potentially useful energy of motion into wasted heat energy. Of course every one has to use the brakes now and then, but the less you use 'em the lower will be your bill for gasoline—and repairs.**

Copyrighted material

CONSTRUCTING A MINIATURE OF

Buffalo Bill's Stagecoach

. . . . Most Famous of Western 'Mud Wagons'



By EDWIN M. LOVE

IN THE picturesque days of the Wild West, it was not alone the red and gilt Concord coach that bore adventurous families from the security of the East to the new empire of the Pacific and carried miners and their boxes of yellow gold from mountain camps to bustling towns. There were also the open-sided "mud wagons." These, for all their belittling title, gave an impression of jaunty and sturdy grace as they sped over dusty roads to the clatter of many hoofs.

One such mud wagon, now standing in the Pony Express Museum of Pasadena, Calif., is said to have been driven by "Buffalo Bill" Cody between Leavenworth, Kan., and North Platte, Neb. This has been carefully measured and reproduced in miniature especially for the model making readers of POPULAR SCIENCE MONTHLY. It is a dashing, colorful little model and carries a human interest appeal that more ornate and complicated coaches so often lack.

Even with its span of horses, the model is of such small size that it is well-proportioned for the average home. The scale is 5/64 in. equals 1 in., and the coach itself is approximately 6 in. wide, 8¼ in. high, and 13 in. long over all.

As it is unwise for anyone to attempt to build a coach model without having full size drawings, three sheets of blueprints have been prepared with all details shown the exact size they are to be made. These drawings can be obtained by sending seventy-five cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY for Blueprints Nos. 144, 145, and 146 (see page 110).

To simplify the construction, all the metal parts or "irons" not actually supporting other parts are cut from cardboard and glued in place; and bolts are represented by pins, with squares of 3/64-in. pasteboard for nuts. Readers who wish to simplify the piece still further may omit undercarriage details, even to the extent of nailing the brake beam to the underside of the reaches and dispensing with the rods and the throw arms.

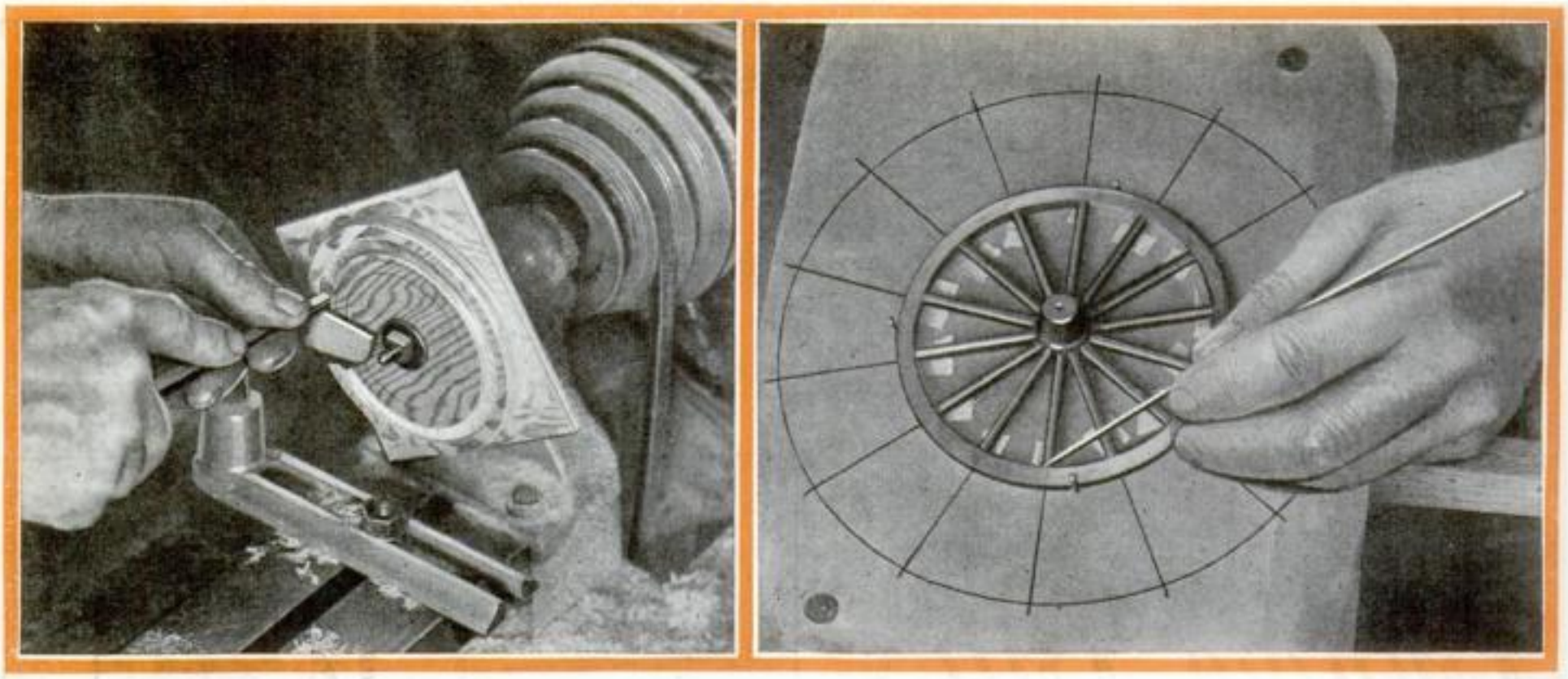
WHEELS. *Felloes:* Center-bolt two thicknesses of five-ply birch and a backing block to a lathe faceplate, and turn the felloes. Surface them to thickness on a sanding disk.

Hubs: Turn a center hole in a block screwed to a faceplate. Drive in a block, and turn a hub. Bore the hole to fit a shoemaker's sewing machine needle, and counterbore to fit the shank.

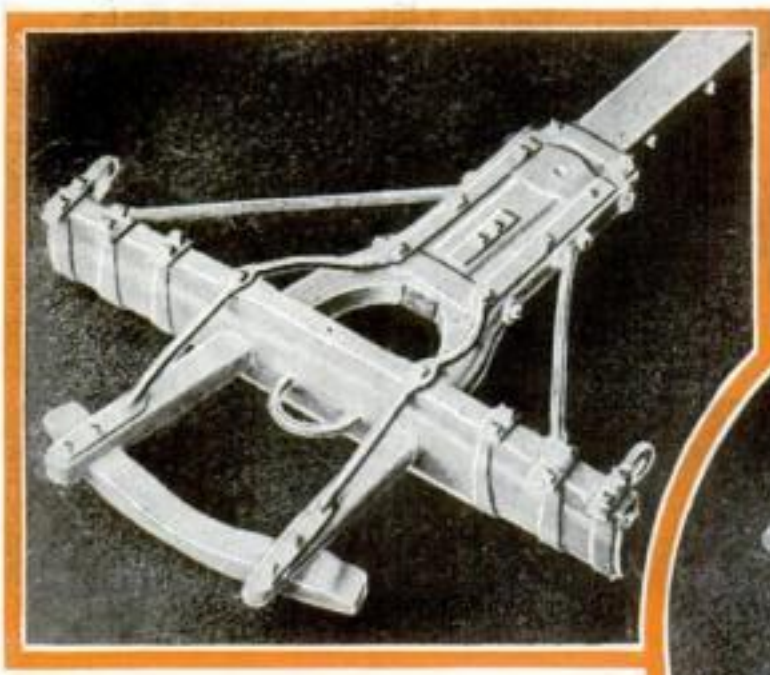
Assembly Jig: Thumb-tack paper to a board and lay out a wheel. Bore the center to fit a hub. Remember that the fore wheels have twelve spokes and the hind fourteen.

Spokes: Prepare four blanks about 3 in. wide—two as long as the fore spokes and two as long as the hind. Gage the ends for a thickness of 7/32 in. at the butts and 5/32 in. at the tips. Size to thickness and cut into 1/8-in. widths in a miter box. Clamp them, one by one, and scrape, file, and sand to an oval section, which

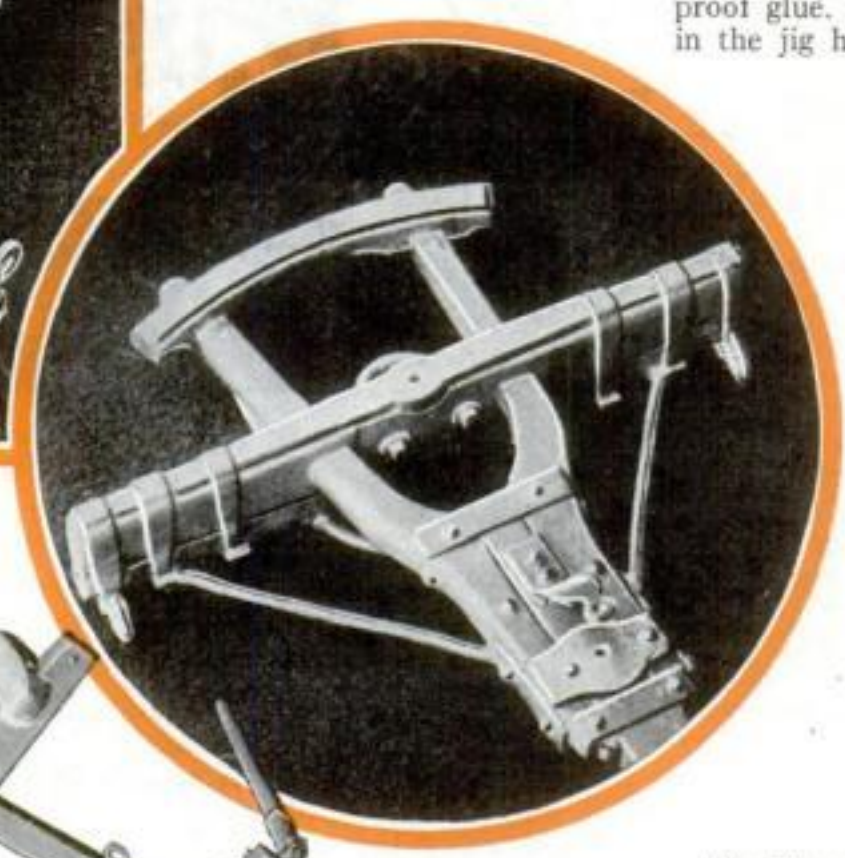
Copyrighted material

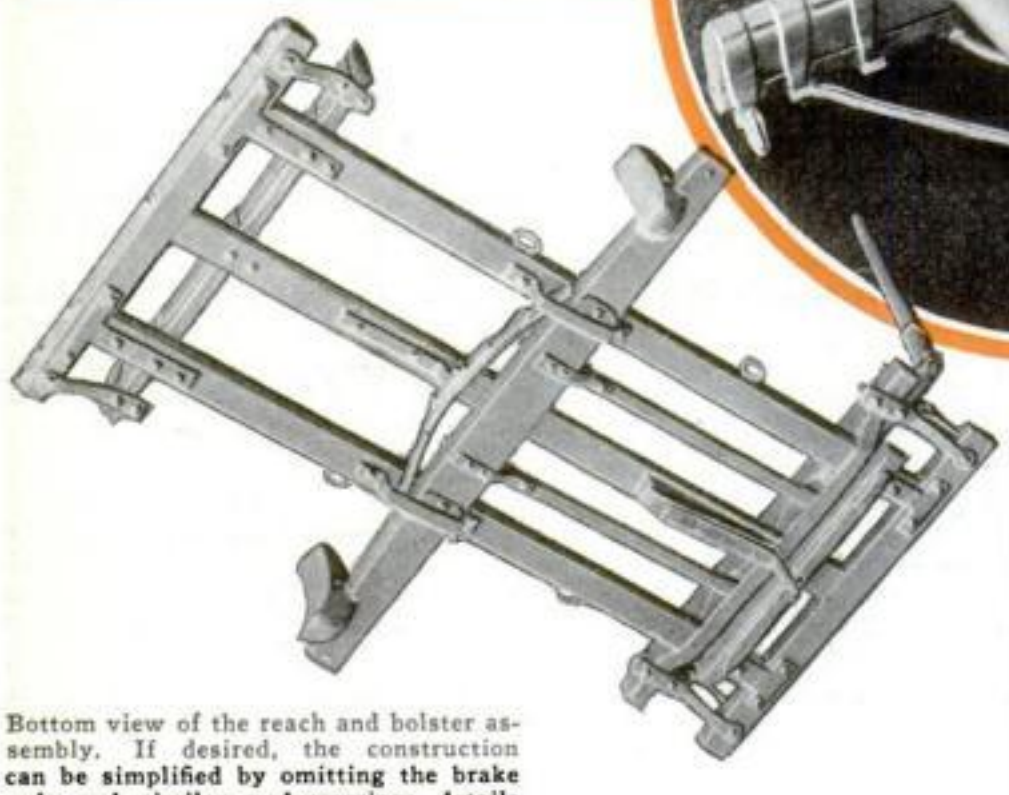


Two operations in the construction of a wheel—turning the felloe *(at left)* and assembling the spokes, felloe, and hub on a prepared assembling jig *(at right)*



At left: Bottom view of the pole (tongue) and fore-axle assembly. The side arms of the hounds are fitted into mortises in the axle





Bottom view of the reach and bolster assembly. If desired, the construction **can be simplified by omitting the brake rods and similar undercarriage details**

Above: Top view of pole and fore-axle assembly. Note the rub iron on top of the hounds and sand plate on top of the axle. The construction of the coach is simplified by using cardboard to represent all the metal parts not actually used to hold other parts. Pins and bits **of cardboard serve to imitate the bolts**

stops at the hub. Leave pointed flats at the outer and inner faces.

Assembly: Use a slow-drying waterproof glue. Insert the outer end of a hub in the jig hole, place the felloe and hold with brads inside and out, then add the spokes. If necessary, taper the butts. Slip bits of cardboard under the outer ends to center them on the felloe thickness, making the wheel flat outside. When the glue is dry, remove the wheel and assemble its mate.

REACHES. The three are alike. Notice that the ends are beveled slightly to meet the shackle bars. Drill holes for the sway strap loops, which are bent from pins and glued in place.

THOROUGH-BRACE SHACKLE BARS. Mark the positions of the reaches by comparison with the plans. Chamfer the ends and the corners between the reaches, to show faces 1/32 in. wide.

Shackles: Bend these to shape, file notches in the shanks, and cement them in their holes. Glue 1/64-in. bristol-board plates and pasteboard nuts in place.

HIND AXLE. Shape the blank to a rectangular section. Trace the axle line, and rabbet 1/64 in. deep from each side to represent the iron. Scrape the shoulders round, make the upper edge half round, and sand. Drill the spindle holes.

Clips: Glue the reach clips over the axle after its assembly with the reaches. The U's resting on the axle ends are of 1/32-in. sheet metal, cut to shape with snips. They are held by sheet metal clips bent around the axle ends with the tips folded into shallow notches under the axle.

BOLSTER. This is square on the upper edge. Notice the profile of the lower edge. The thorough-brace U's are spaced like those on the hind axle. The clips clasp beneath, without notchings, as the understrap builds up flush with the bolster.

SAND BOARD. Notch to fit reaches.

Copyrighted material

BRAKE THROW IRON. Bend the wire to shape, hammer the flat part that attaches to the handle, cut to length, and file to shape. The square socket is cardboard, added after the handle is riveted on. File the throw arms to shape, drilling them for clevis pins, and solder at 45 deg. with the handle.

Handle: Notice the shaped handle and the foot iron. Glue leather around the wood, taping it until dry.

BRAKE BEAM. Note the reach rub plates of 1/64-in. cardboard.

Blocks: Notch over the rear edges of the beam, and cant to fit the wheels. Drill the beam each side for eye bolts bent of 3/64-in. wire, similar to shackles.

SPRING ASSEMBLY. Make three spring-brass leaves and drill for rivets.

T-Iron: Make of sheet metal, drill for rivets, bend the head at right angles to the shank, and rivet it to the spring.

BRAKE RODS. Note the canted notch to receive the beam, the iron (made of sheet metal) below, and the clevis irons.

CARRIAGE ASSEMBLY. *Frame:* Glue and nail the shackle bars to the reaches. Add the hind axle, bolster, sand board, and bolster strap passing under the reaches.

Irons: Cut from sheet metal the brace irons yoking the thorough-brace clips and bolt them beneath the shackle bars. Glue 1/32-in. cardboard T-plates under the outer reaches and the hind shackle bar. A 1/32-in. sheet metal T-iron rests on the center reach over the sand board, with a pin to represent a bolt in each wing just outside the reach; these pins pass into the sand board. The brake-beam loops, inclosing the beam, come next. Be sure to thrust the fore ends of the rods between the bolster and the sand board before securing the loops. Likewise bolt the spring T in place. The hound rub iron, with its prong to act as an emergency king pin, is mounted on a wedge. Mount the brake throw iron.

POLE ASSEMBLY. *Pole (Tongue):* To make the stock for the hooks, file nails to a point while turning them in a drill chuck, and bend to shape. The wedge-shaped shanks enter one vertical hole.

Fore Axle: The end-clip yokes are shanks of stay-chain hooks. Those next are shanks of the stay rods.

Hound Side Arms: These are glued into the axle mortises and bradded to the pole.

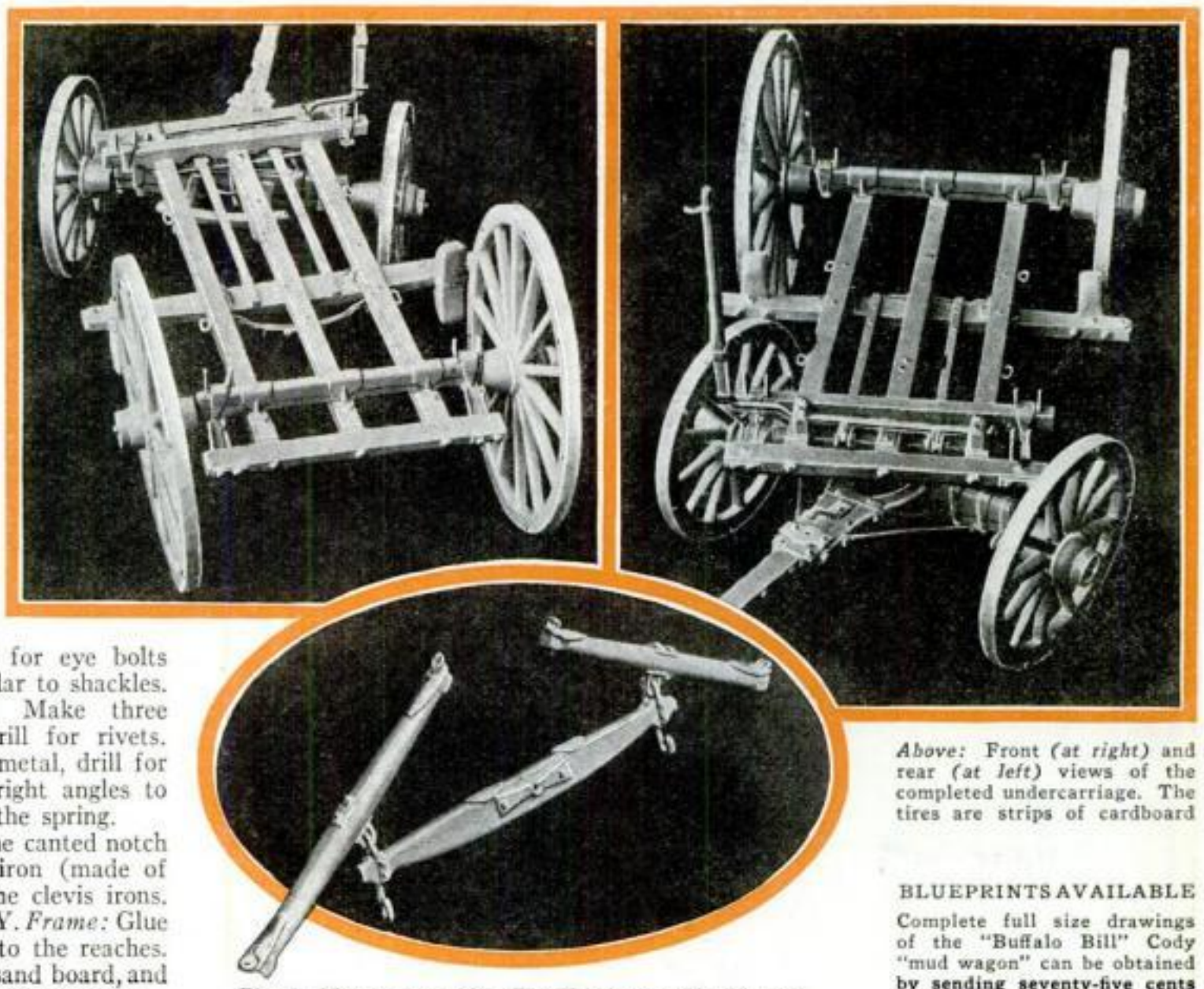
Hound: Notch over the side arms.

Irons: The rod ends enter the side arms and are finished with bolted cardboard surface flats, or are flattened to bolt under the fore axle.

DOUBLETREE ASSEMBLY. *Doubletree:* The U-bolts are wire, continuous with the stay-chain hooks. Rivet to the ends with pins, and glue on nuts.

Singletrees: These are round, tapering to square ends with cardboard ferrules.

Directions for finishing the coach will be given in the February issue, and instructions for carving the horses and making the harness will appear in March.

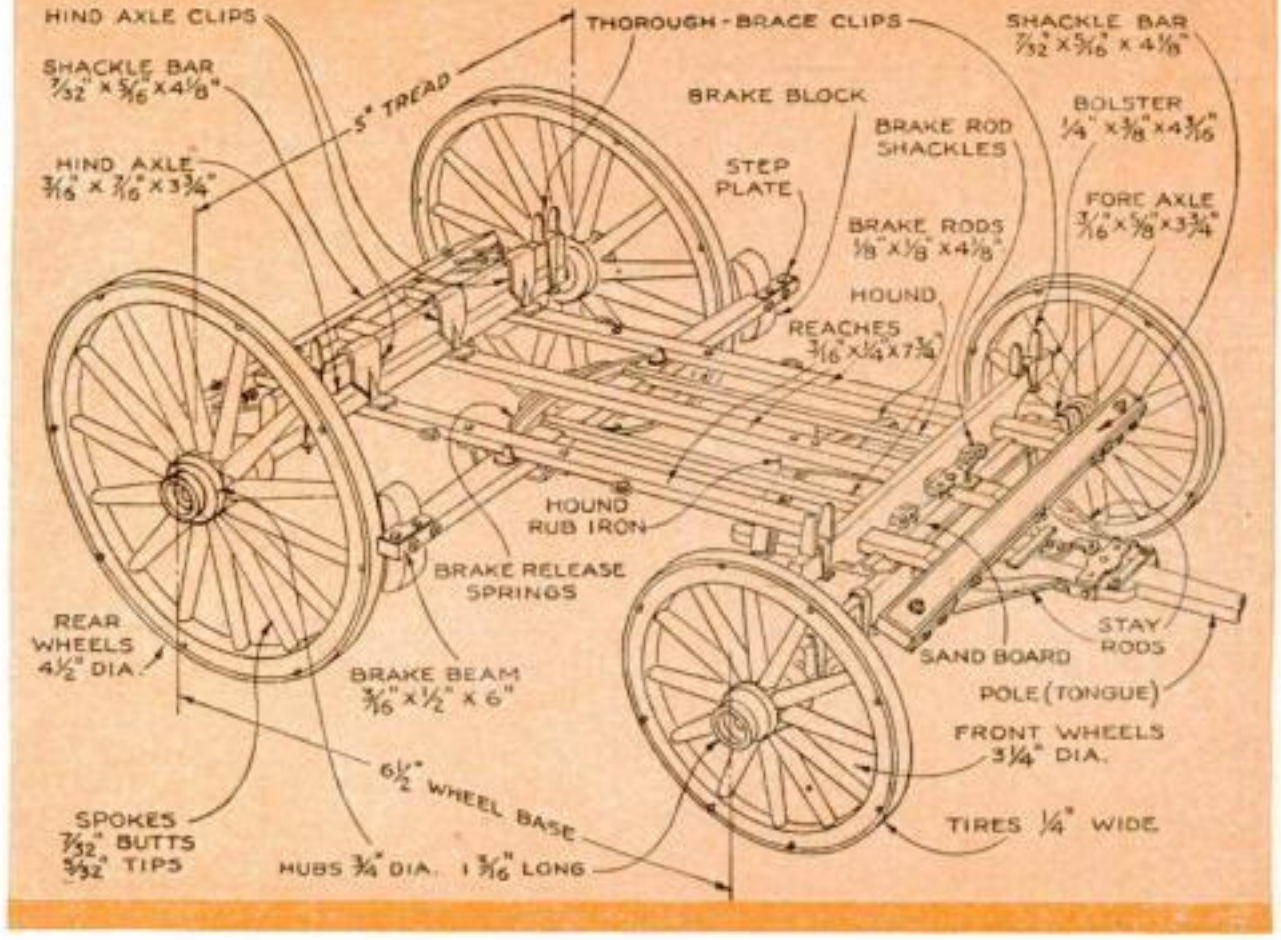


The doubletree assembly. The U-bolts are of wire, and nuts, bolts, and ferrules are imitated with cardboard

Above: Front *(at right)* and rear *(at left)* views of the completed undercarriage. The tires are strips of cardboard

BLUEPRINTS AVAILABLE

Complete full size drawings of the "Buffalo Bill" Cody "mud wagon" can be obtained **by sending seventy-five cents for blueprints Nos. 144, 145, and 146 (see list page 110)**



Sketch of the undercarriage showing the locations of the various parts. The brake lever has been omitted for clearness

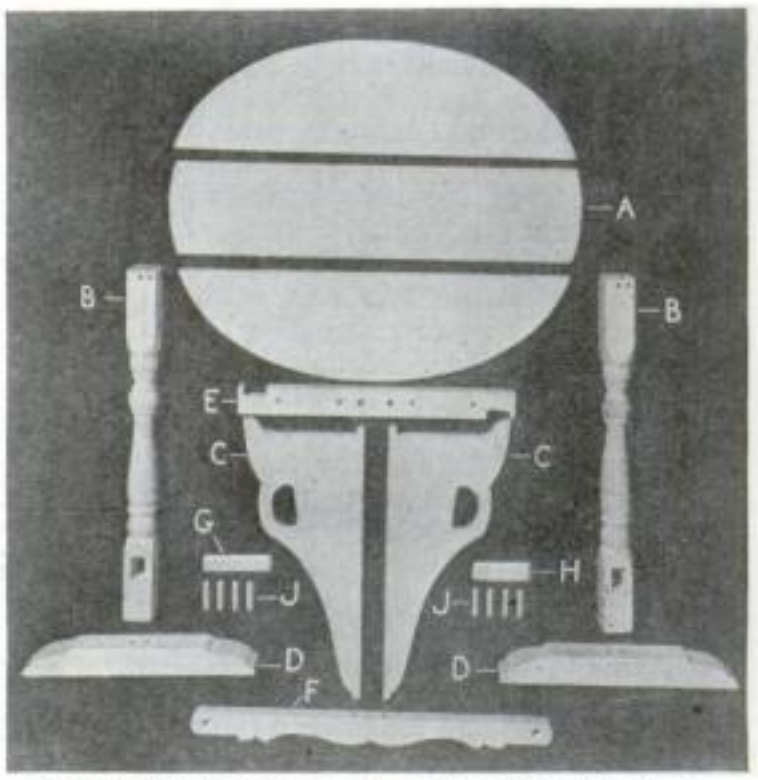
Copyrighted material

Announcing a New and Unique Service for Readers . . .

Two views which show how the butterflies open to support the drop leaves of the table. *At left:* The accurately machined parts are very easy to assemble

The POPULAR SCIENCE HOMECRAFT GUILD

It will provide you with amazingly low-priced construction kits for building furniture of the finest quality from the choicest woods



In addition to these wooden parts, the kit contains the hardware and three cans of finishing materials

TO HELP you build superlatively beautiful pieces of furniture at low cost and with the least possible difficulty, POPULAR SCIENCE MONTHLY has established a new service organization to be known as the Popular Science Homecraft Guild. As its first undertaking, the Guild offers a complete construction kit for the Colonial butterfly table illustrated, which was made from plans by one of the world's foremost furniture designers. All the parts for this table prepared as shown at the right and practically ready for assembly, together with the hardware and the material for finishing it by a remarkable new method, will be sent to any reader in the United States for $6.90. A coupon for your convenience in ordering this kit is given on page 100.

The table, which is of maple, has an oval top 17 by 22 in. and stands 22½ in. high. It is typical of certain New England pieces dating from 1700. Its name is derived from the two wing-shaped supports which turn out to hold the drop leaves in the raised position. The handgrip or opening in each butterfly is unusual; in fact, there are only a few historical pieces in existence which have this feature.

The uses of a small table of this type are innumerable. It can be placed beside a chair or sofa, either in the living room or a bedroom, to hold a lamp, books, smoking accessories, and other small objects. It might also be set alone in a corner or used in a hall or reception room.

The wooden parts of the construction kit consist of the oval top *A* in three pieces, two turned leg posts *B*, two butterflies *C*, two trestle feet *D*, one top rail *E*, one lower crosspiece or stretcher *F*, the wood *G* and *H* for making two wedges and two stops for the butterflies, and eight dowel rods *J*. Other parts provided with the kit but not illustrated are two pairs of hinges, all necessary screws, three cans of finishing materials, and cheesecloth for the finishing pads.

Almost any household tool assortment will be sufficient for the small amount of work which remains to be done on the pieces prior to assembling them. It is advisable to obtain a 10- or 12-in. cabinet rasp and also a cabinet file (or a half-round file) for rounding edges. Hand screws or a pair of cabinetmaker's bar clamps are convenient for clamping the glued joints, but other methods of holding the parts can be devised without difficulty, or a simple wedging device made as shown in one of the drawings. A few sheets of Nos. 1 and 00 sandpaper will be needed, and a little cold water (casein) glue, cabinetmaker's hot glue, or high-grade liquid glue, as preferred.

The preparatory work should be done as follows:

1. Round back the outer edges of the

Copyrighted material

W*hat the* Homecraft Guild W*ill* D*o for* YOU

1 It will supply construction kits for making furniture of the finest quality. Every piece will be the work of one of the country's leading designers of custom-built furniture and, like the butterfly table, will be made exclusively for home assembly. Not one will be distributed by ordinary furniture stores; in fact, furniture of equal distinction is found only in the best appointed homes.

2 The wood will be of a grade that most readers cannot purchase except at an excessive price and will be much superior to anything that can be obtained in the average lumber yard. It will be selected to suit exactly the character of the design. If, for example, a piece should be made of mahogany, not only will mahogany be provided, but it will be the very type of mahogany—and there are a number of different varieties—which an expert would choose for making a reproduction of what is called a "museum piece," or for the highest class of made-to-order furniture.

3 The kits will be economical in the best sense of the word. There will be no waste whatever. You will not have to buy a whole board of some costly wood in order to cut out a few pieces, or pay for several boards of different thicknesses when only a part of each is needed.

4 The construction will be simple. All the machine work will be completed, and the wood will be sanded to a flawless surface. What little hand finishing is necessary before assembling the pieces will require relatively few tools. It will, indeed, be the most enjoyable part of the work because it will give the pieces individuality—that handmade look which distinguishes custom-made furniture from the ordinary factory product.

5 Special materials will be provided for a type of finish that is at once easier to apply and of higher quality than any other ever before offered to amateurs. No skill with a brush is needed, because the materials are applied with cheesecloth pads.

The butterfly table used as an end table with one leaf of the top down and the other up. The finish is antique maple

three toppieces *A* with rasp, file, and No. 1 sandpaper as shown in one of the sketches.

2. Round the edges of butterflies *C* and of the handgrip holes. File the projections at top and bottom of *C* to a diameter that will fit easily in the holes in stretcher *F* and the corresponding holes in top rail *E*.

3. On feet *D* mark where the square ends of the leg posts are to rest; then slightly round the edges of the piece everywhere except at the place where this joint is to be made and along the bottom.

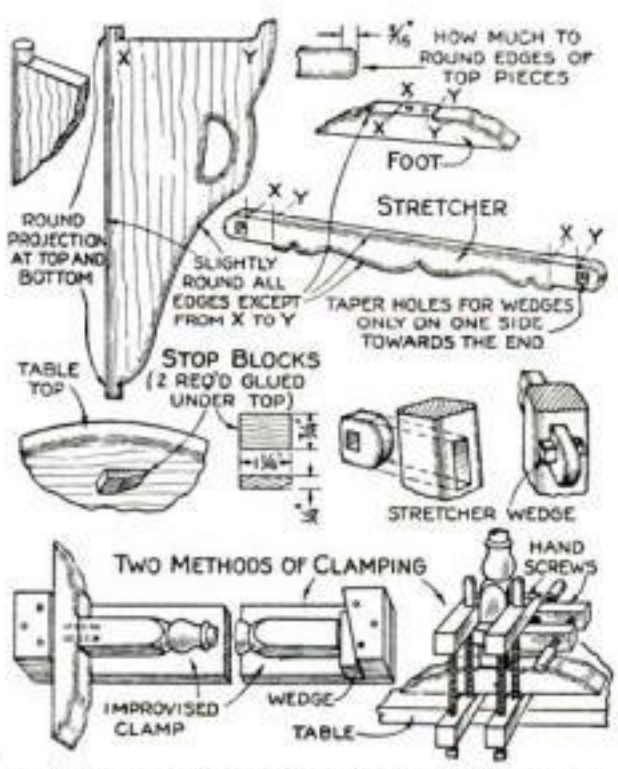
4. Round the upper and the lower edges of the stretcher *F* except where it is to pass through the holes in leg posts *B* (see drawing). At these points, it will be seen, is a shoulder which fits against the leg post; make the corner of the shoulder perfectly square and true, because you will find that the machines have left it slightly rounded in the corner. The small mortise holes at the ends of the stretcher *F* are intended to receive wedges, therefore slightly taper them by filing. This taper should be on the outer side or end of the square hole so that the wedge will act to pull the shoulder tightly against the leg post. Prepare two wedges from piece *G* to fit the tapered holes. Leave them somewhat long so that they can be cut off after being fitted. They should finally be about 1¼ in. long.

5. Sandpaper leg posts *B* so there are no sharp edges either on the turnings or on the square parts, but, of course, leave the edges of the mortise holes square and sharp.

The steps in assembling are:

1. Attach feet *D* to leg posts *B*. First bevel off or chamfer the ends of each dowel with a file so they will enter the holes easily. Make a trial assembly without glue. Be sure the feet are square with the leg posts. This can be accomplished by doing the assembling and gluing on an absolutely flat surface. Get ready whatever means of clamping you intend to use. Often the bench vise can be used to obtain the necessary pressure. Hand screws, if available, may be applied as shown in one of the sketches. If nothing else is at hand, a wedge clamp like that suggested in another of the drawings may be prepared from scrap lumber. Be sure that the mortise hole in each leg post runs through the leg at right angles to the foot. Apply sufficient glue to provide contact between the dowels and the dowel holes and between the faces of the joint at all points; then clamp the parts together. Not much pressure is required, but it is most important that the joint should not be jarred or disturbed until the glue is dry (dependent on glue used).

2. When the glue is dry on the two legs and feet, the assembly can be completed in one operation. Bevel off the ends of the dowels as before to join leg posts *B* and top rail *E*. Make a trial assembly, setting the butterflies in their socket holes in top rail *E* and stretcher *F*. See that the butterflies are placed so that they will open into their respective notches of rail *E* at opposite ends of the table, one butterfly being on one side and the other on the other side of the rail. If the butterflies do not turn freely, file the pivot pins until they do. *(Continued on page 100)*



Where to round the edges; how to prepare the wedges and stop blocks; and clamping methods

Copyrighted material

USING A HACK SAW FOR LONG CUTS

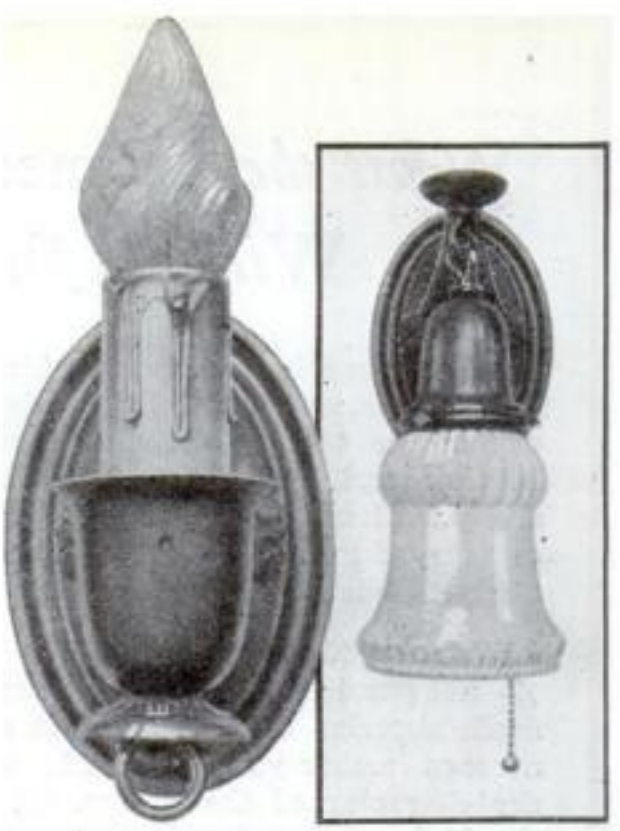
IT OFTEN becomes necessary to cut through a large piece of sheet metal when only an ordinary hack saw is available and when the line is so far from the edge that it does no good to turn the blade at right angles to the frame. The work can be done, however, if two cuts are made, one along the desired line and another ⅜-in. outside it. The long slim piece of metal between the cuts can be turned up and rolled out of the way, leaving space through which to work the hack saw frame. Another hack saw stunt to remember is that curves as short as 3 in. in radius can be cut without much danger of breakage provided the blade is not tightly stretched in the frame. Worn-out hack saw blades make excellent paint stirring paddles for use in small cans, for they are sufficiently stiff and do not waste paint through adhesion to the same extent as a paddle made of wood.—JACK HAZZARD.

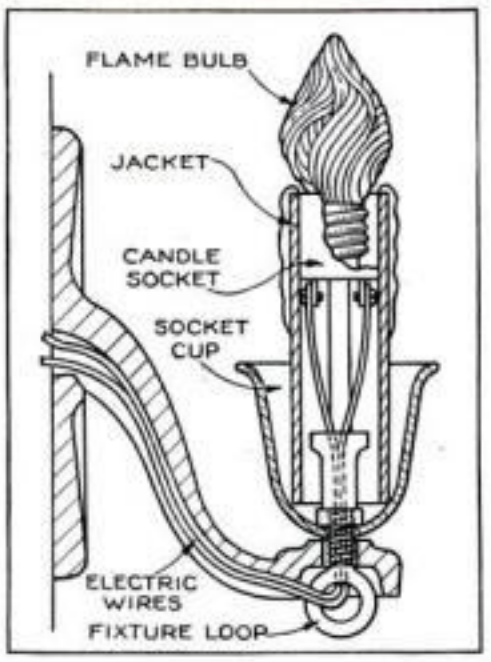
STENCILED STARS BRIGHTEN CEILING

AS THEY are ordinarily painted, the ceilings of small reception halls and of halls which serve to connect two rooms contribute nothing of interest to the decorative effect. Frequently the halls are dark and may well be given a bright color treatment, either plain or with an attractive design. Small hall ceilings in homes which are Colonial or Early American in character can be improved in decorative value in a good many cases by using the historically correct star design illustrated below. The ceiling was first painted white with a paint that would dry flat. This was then stippled; that is, it was pounded while wet with a large, dry stippling brush to put a fine pattern in it and eliminate the brush marks. Next, a stencil was made from a sheet of manila drawing paper by cutting out stars of five, six, and eight points and in four sizes, all placed at random. Regular oiled stencil board, of course, would be better to use than manila paper. Some of the stars were stenciled on the white ground with a medium shade of bright blue, others with gold bronze, and the remainder with aluminum bronze. Cobalt blue and white artists' oil colors, thinned with turpentine, were used; and the dry bronze powders were mixed with equal parts of good floor varnish and turpentine. When all of the stars were dry, the clouded effect was added with a mixture of cobalt blue and one part each of turpentine, boiled linseed oil, flat varnish, and benzine. The amateur will find it easier to mix the blue with a ready-mixed glazing liquid sold for the purpose by most paint stores, or with what is called "flatting oil." The blue was spread over the whole ceiling and stars, then patted and wiped while wet with cheesecloth to form clouds.—F. N. VANDERWALKER.

The stencil contains stars of assorted sizes

A small portion of a ceiling to show the correct arrangement of the stars, and, at left, the stenciling process. **A clouded effect is afterwards added**





HOW TO MODERNIZE OLD ELECTRIC FIXTURES

PRACTICALLY any antiquated type of electric lighting fixture can be brought up-to-date at very small cost, and the work can be done in your own home. The accompanying illustrations show how this was accomplished with one style of fixture that was formerly popular and is still to be seen in thousands of homes throughout the country. Almost any similar type of side-wall bracket and even many of the chandelier type may be modernized in the same way. The shade is first removed, then the cup that incases the socket is taken off, and the socket is removed. With tin shears, cut the lower rim off evenly and smooth it up with a file. This will leave a bell-shaped piece as shown in the drawing. Purchase the required number of candle sockets from any electrical supply store, and proceed with the assembling as follows:

Screw a so-called "male" fixture loop up through the arm, or bracket, and set the socket cup over this to form a saucer for the candle socket. Now screw the candle socket on to the threaded end of the fixture loop inside the cup, and attach the electric wires in the same way in which any socket is wired. Slip the jacket over the socket and screw in a flame bulb. If you have fixtures that differ from the one shown, study them for a few moments. In most cases you will find that they can be modernized.—DICK HUTCHINSON.

Copyrighted material

Better Photographs *by* Artificial Light

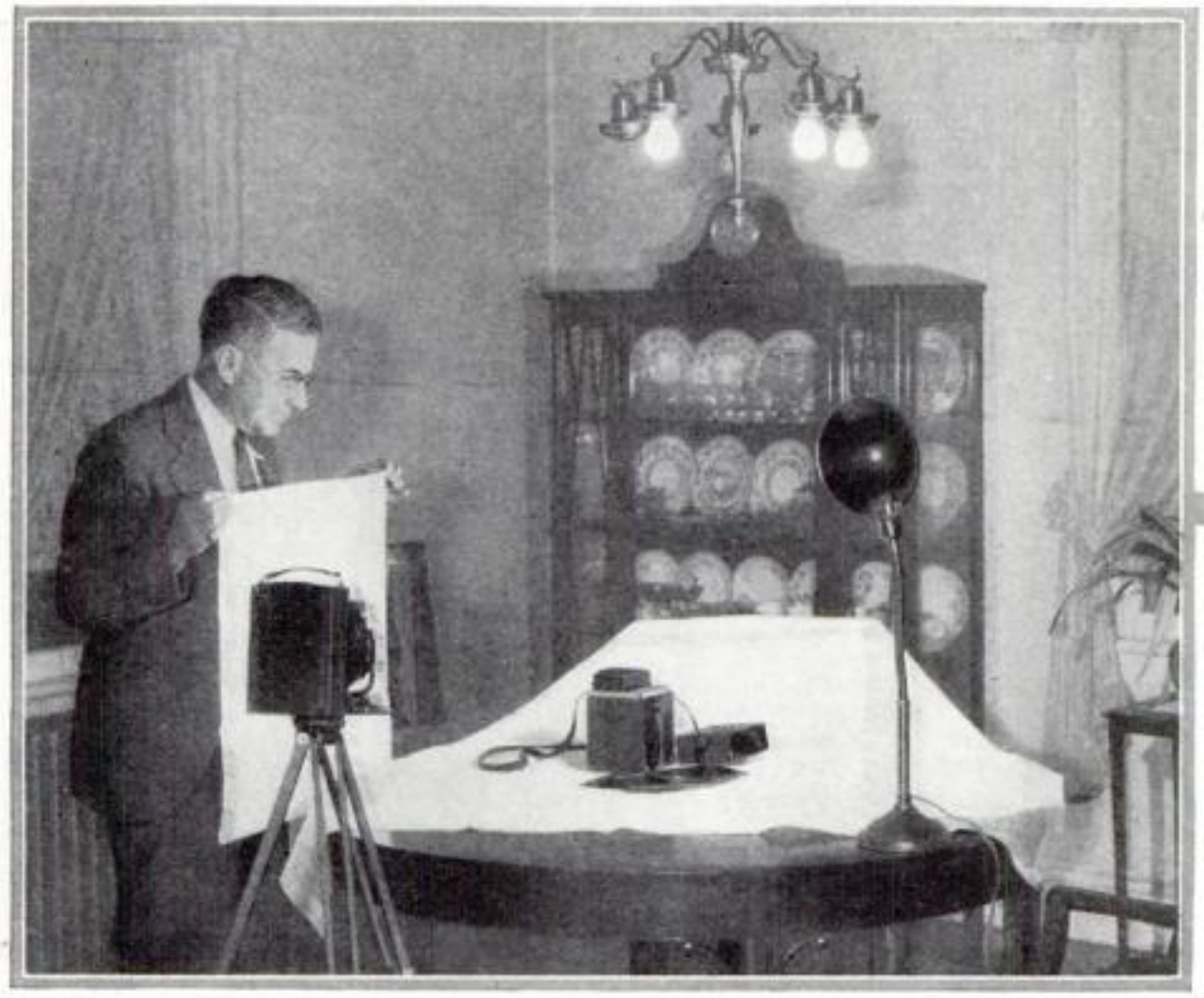


Fig. 1. An ordinary 50-watt bulb in a suitable reflector will furnish ample illumination for still-life photography. A napkin held opposite the light will eliminate dense black shadows

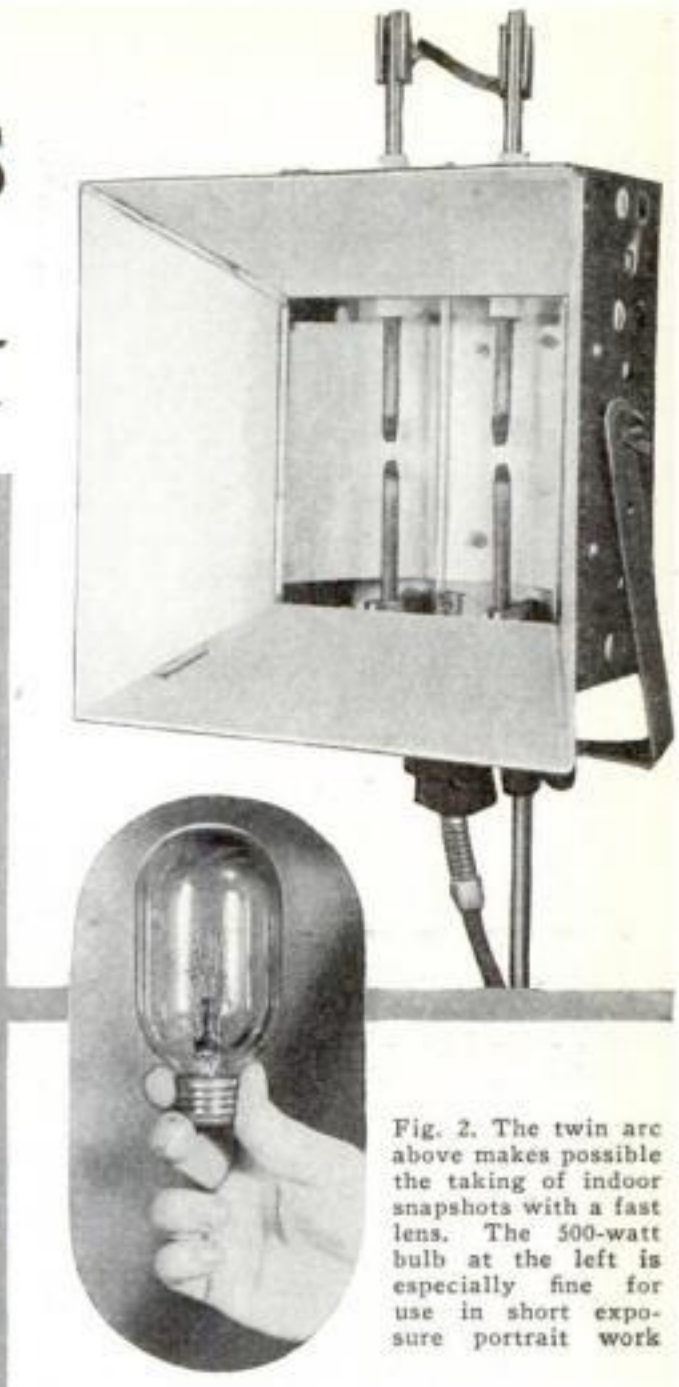


Fig. 2. The twin arc above makes possible the taking of indoor snapshots with a fast lens. The 500-watt bulb at the left is especially fine for use in short exposure portrait work

By Frederick D. Ryder, Jr.

ONE of my neighbors contracted the photographic fever last spring, bought himself a camera, and all through the summer was the local photo finisher's best customer. I stopped around the other night to see how he was getting along.

"It's a shame summer doesn't last all the time," he told me. "No chance to take pictures now except on Sundays, and even then the light is good only for a few hours."

"You don't have to limit yourself to outdoor snapshots," I suggested. "Why not try a few shots by artificial light? It's just as interesting—maybe more so."

"Why waste film that way?" he exclaimed. "I don't know anything about artificial light. How would I dope out the exposures? Besides, you have to have special lights, don't you?"

I suppose there must be a lot of people who, like my neighbor, pass up chances to take good pictures by artificial light just because they don't realize how easy it is.

In the first place, large and expensive lights are not necessary except for pictures of babies and small children. Portraits of grown-ups or children old enough to sit still for a few seconds, interior views, or any still life subject can be taken with very moderate lighting equipment. In most cases, the electric light bulbs you have on hand will be sufficient. Of course, flashlights can be used for all these jobs, but flashlight work really is another subject. I shall discuss this branch of photography next month.

Still life subjects are the easiest, of course, to photograph by artificial light; there being no chance for motion to spoil the picture. Long exposures can be given with light from house-size electric bulbs. Suppose, for example, you desire to take a picture of some object about the house; perhaps a product of your own home workshop.

First arrange it against a suitable background which will contrast with it in color. Do not, however, use a white sheet if you can avoid it. Medium blue or very light yellow cloth photographs to a pleasing shade between plain white and pearl gray and does not cause a glaring effect.

A suitable arrangement is shown above in Fig. 1. At the right is an ordinary table droplight containing a 50-watt bulb. The subject in this case happens to be a special plate-holder case. I arranged it against a yellow tablecloth background, set up the camera, turned on the light, and then, standing at the side opposite the light, I held up a white napkin so that it would reflect light on the subject and eliminate the dense black shadows always formed by a single light source. The exposure was 48 seconds with the lens stopped to 16. If I had used a 100-watt bulb, the exposure would have been about 24 seconds. Other conditions remaining the same, the exposure always is roughly in proportion to the wattage of the lights used.

In figuring artificial light exposures, remember that the distance from the light to the object being photographed is extremely important. If I had moved the light twice as far away as is shown, the exposure would not have been 96 seconds, but instead would have been close to 3 minutes and 12 seconds. The light intensity at the object is inversely proportional to the square of the distance to the light.

YOU can understand this by taking a piece of cardboard 4 by 5 in. and holding it 10 in. from a point source of light such as an automobile headlight bulb. Its shadow will cover another piece of cardboard measuring 8 by 10 in. placed 20 in. from the light. The light that hits the 4 by 5 in. cardboard at 10 in. is spread out over four times the area by the time it gets 20 in. away from the light. Therefore a 4 by 5 in. area on the 8 by 10 in. cardboard would reflect only one fourth as much light to a camera lens as would the same area placed only 10 in. from the light.

If you have some natural artistic ability, you can produce some very interest-

Copyrighted material

ing still life photographs of flowers in vases and other objects. The use of artificial light actually is an advantage in such photography. You can arrange the position of the light to get exactly the shadow effect and the modeling of the object which appeal to your artistic sense.

Of course, it is not necessary to use a napkin or sheet as a reflector to lighten deep shadows. Another electric light bulb will do the trick and also cut down the exposure time. Never use exactly the same size of bulb on both sides of the object, as this will result in making the picture flat and lifeless. If you have two bulbs of the same size, one can be placed farther away than the other.

Always study the lighting before you make the exposure. Stand as nearly as possible in line with the camera lens and remember that the camera records only lights and shadows—not colors.

Taking portraits presents exactly the same problem in lighting except that it is desirable to use as large bulbs as convenient to cut down the exposure time.

A fast lens in portrait making is a big advantage. With a lens working at F/4.5 you can get a good portrait in 1 second using a 200-watt bulb for the main light and a 100-watt bulb on the other side. If your camera takes plates, you can use the new supersensitive panchromatic film and cut the exposure to 1/5 second.

Going still higher in light power, you can get a 500-watt bulb for $3.50 that is especially made for photographic work and produces much more light than 500 watts worth of ordinary bulbs. Such a bulb is shown in Fig. 2. It can be used only in the vertical position with the base down.

Arc lights also present possibilities to the amateur who is interested in indoor photography. There are several small types ranging in price from $4 to $8 that will give excellent results. The grandpa of them all is the twin arc light also shown in Fig. 2. This outfit costs $25 and draws 15 amperes. It will permit indoor snapshots at 1/25 second using an F/4.5 lens and the supersensitive panchromatic film. A still faster lens will permit snapshots on ordinary film, and such a light makes indoor home movies quite practical.

Of course, the size of the light does not improve the picture. A picture of a stationary subject taken with a 50-watt bulb and a long exposure would be exactly like a snapshot taken with the twin arc. The big lights are needed only when the subject won't stand still.

Once you have accurately worked out the proper exposure for a given type of subject with lights of a known power placed at measured distances from the subject, you can take picture after picture under the same conditions without running any chance of failure. In taking indoor, artificially lighted subjects under known conditions there is none of the uncertainty regarding exposures that you always encounter when photographing outdoor scenes where the intensity of the daylight varies.

Interior views showing the details of your home are simple, too, and ordinary bulbs will do the job. Try to place them so that the lighting is as even as possible and avoid having any unshaded bulb where it will appear in the picture. In long shots, where a portion of another room shows through a doorway, pleasing effects can be obtained by additional lights placed beyond the doorway out of line with the camera.

The next article in this series will be on flashlight photography. If you have any questions to ask about photographic problems, write to Mr. Ryder in care of this magazine and inclose a self-addressed, stamped envelope for reply. In sending a print to be criticized, inclose the film also; it will be returned with his letter of comment and suggestions.

$10 PRIZE *for the best* Photograph *taken by* Artificial Light

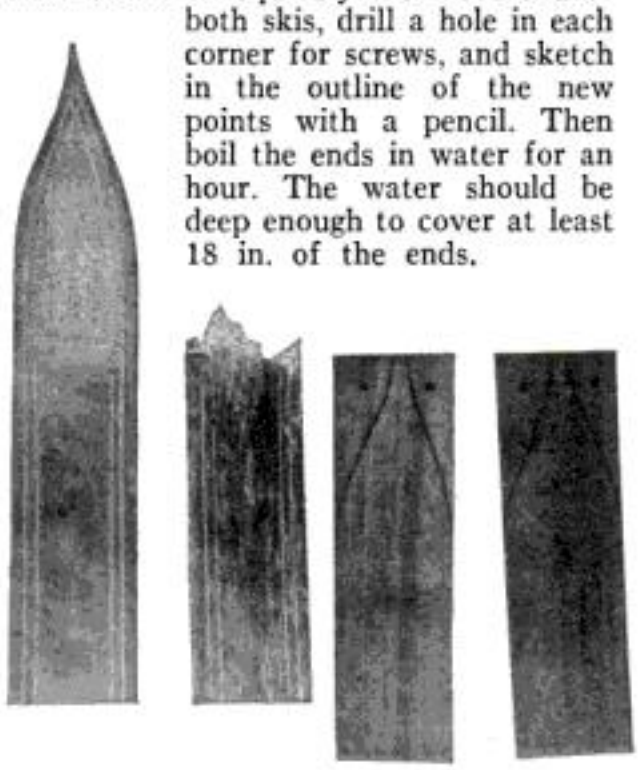
POPULAR SCIENCE MONTHLY will pay $10 for the most photographically perfect picture taken by artificial light (but not by flashlight) and submitted on or before February 1, 1932. The only condition is that it must be taken during the months of December, 1931, and January, 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photographic Editor not later than February 1, and mark your entry "January Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with entry.

Winner of Fourth Contest

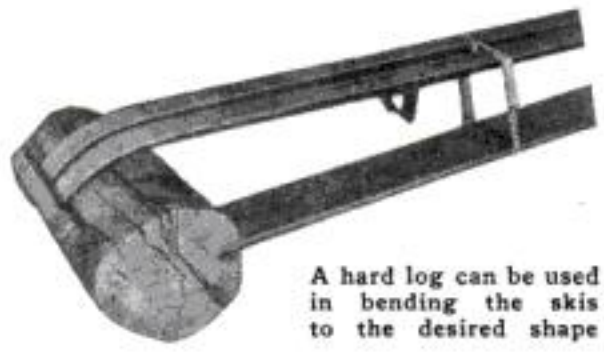
Harrison N. Mucher, of Reading, Pa., has been awarded the $10 prize for the best picture in the photographic contest announced in the fourth article in the series (P. S. M., Sept. '31, p. 83). Those winning honorable mention are as follows: Mrs. J. Amidon, Colorado Springs, Colo.; Harry A. Austin, Medford, Mass.; A. E. Grix, Jersey City, N. J.; James E. Harris, San Francisco, Calif.; William Hild, Chicago, Ill.; Thomas K. McGrath, New Britain, Conn.; J. O. Peterson, Spokane, Wash.; and Mrs. W. H. Smith, Wichita, Kan. The winner of the October, 1931, contest will be announced next month.

SALVAGING SKIS WITH BROKEN TIPS

WHEN the tip is broken from one of a pair of skis, it is not difficult to make a serviceable repair by the method illustrated. Cut off squarely the front end of both skis, drill a hole in each corner for screws, and sketch in the outline of the new points with a pencil. Then boil the ends in water for an hour. The water should be deep enough to cover at least 18 in. of the ends.



Both skis are first cut down to the same length, and the new outline is plainly drawn

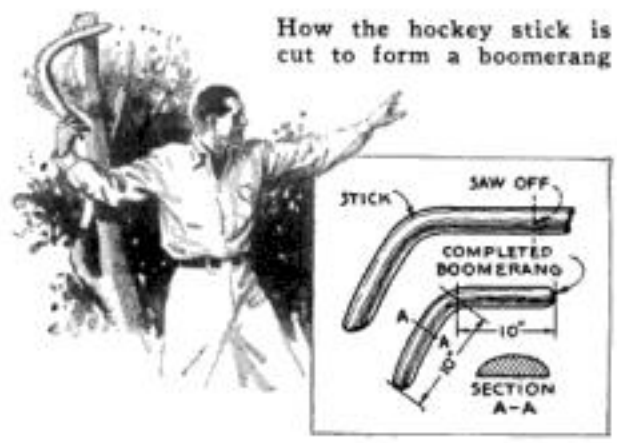


A hard log can be used in bending the skis to the desired shape

As a bending form, use a log or other object having a suitable curvature. Fasten the ends of the skis with screws as shown and bend them about 10 deg. beyond the desired curvature. Hold them in position by tying them to a board nailed to the underside of the log or form. Allow the wood to dry in a warm place for forty-eight hours. The ends then may be reshaped with a spokeshave and smoothed with sandpaper. Cut about 3 in. from the back end of each ski to restore the balance. Sandpaper the top surface and apply two coats of spar varnish.

While the upturned ends will tend to straighten slightly, the fact that they were overbent 10 deg. will result in their retaining approximately the correct curvature.—EVERETT EAMES.

How the hockey stick is cut to form a boomerang

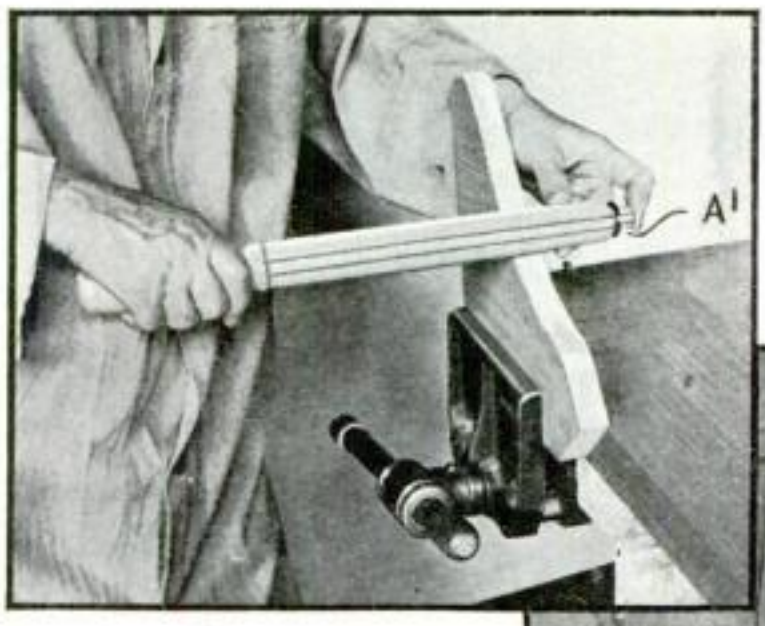


BOOMERANG MADE FROM OLD HOCKEY STICK

A BOY'S hockey stick with a broken handle or other imperfections can be transformed into a boomerang with very little work. Measure the length of the bent portion or hitting end and saw off the handle to the same length. This will give you a piece shaped like a boomerang. Clamp this in a vise with one flat side up and round off the surface as shown above. The other side is left flat. Smooth the wood with fine sandpaper and apply two coats of thin varnish. An explanation of how to throw a boomerang can be found in books on sports and even in some encyclopedias.—L. B. ROBBINS.

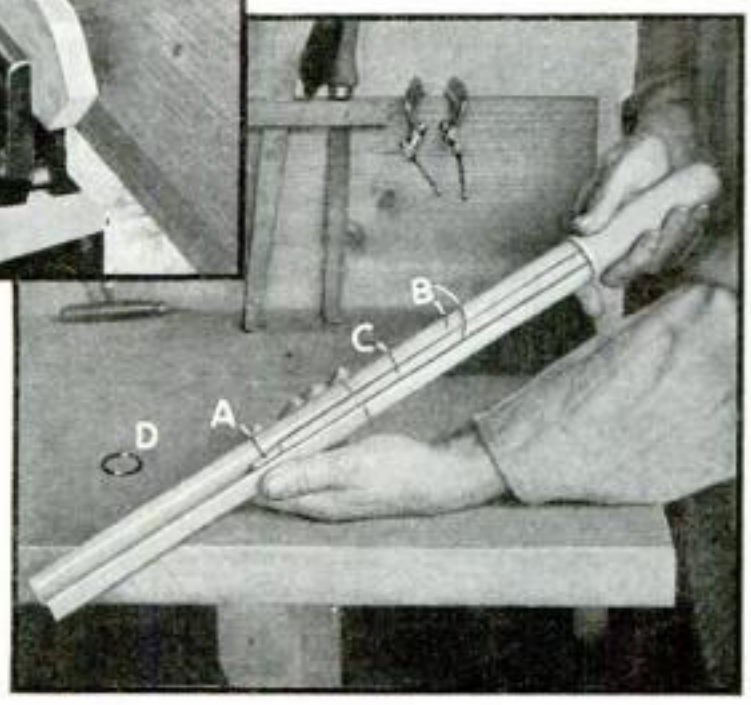
Copyrighted material

SANDPAPER "FILE" FOR CURVED WORK

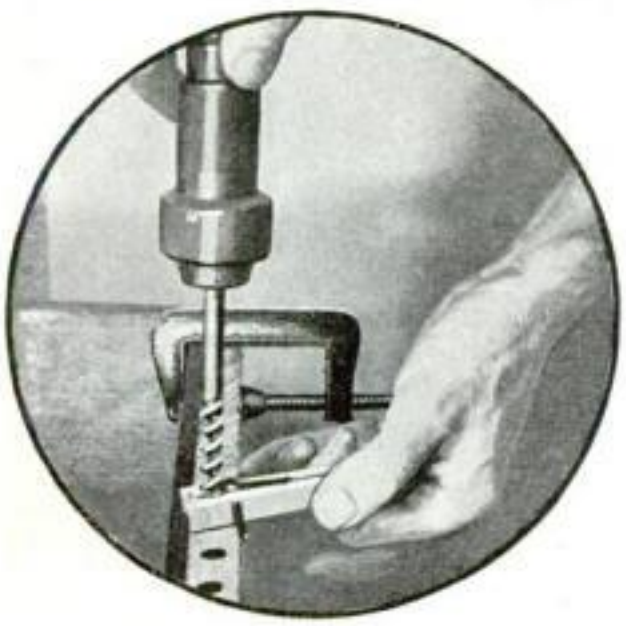


How the tool is used for smoothing the edges of curved woodwork after a sharp spokeshave and a regular cabinet file have removed most of the irregularities left by the saw

The sandpaper is slipped over the cylinder as shown below, the edges being folded over about 1 in. to enter the long saw slots marked *B*



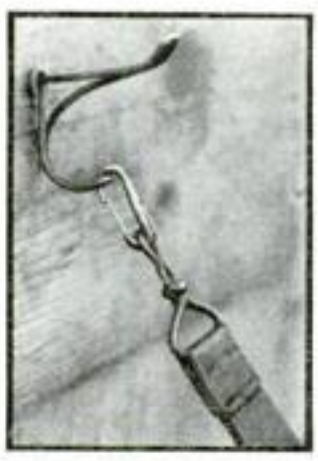
THIS round sandpaper "file" should have a place in every home shop in which there is a band saw or a scroll saw or where much curved woodwork is done. It provides an effective and timesaving way to smooth curved edges after a spokeshave and file have removed the worst places. Cut a piece of pine or similar wood 1½ in. square and 15½ in. long. Center it in the lathe, rough it down to about 1⅜ in., and pencil mark the lengths of the handle, 4½ in., the shaft, 9 in., and the tapered end *A*, ¾ in., which will leave about ⅝ in. at each end for chuck waste. After turning the handle, make the shaft about 1¼ in. in diameter at the grip end and a very little smaller at the other end to allow the sandpaper to be pushed on easily. Make the tapered end *A* fully ¾ in. in diameter at the shaft and perhaps ⅛ in. smaller at the very end. With a thin, smooth cutting hand rip saw, make the two cuts *B* about 5/16 in. apart along one side but coming together in a single cut on the other side, so as to leave piece *C* V-shaped in section. This piece is entirely separated from the shaft except at the handle end. The sawing may be done on a band saw if desired, by making a cradle to hold the shaft from turning. Fold one end of a piece of sandpaper for about 1 in. into one of the cuts marked *B;* then wrap it around the shaft, mark the location of the other cut *B*, add 1 in. for folding in, cut the sandpaper, and push it on the shaft as shown. Slip a ¾-in. ring *D* over the tapered end as indicated at A^1.—C. A. K.



CLOTHESPIN BIT GAGE

WHEN a number of dowel holes or other holes must be bored to approximately the same depth and a regular auger bit gage is not at hand, it is possible to use a spring type wooden clothespin as a depth indicator. Bore one hole to the desired depth; and, before removing the bit, snap the clothespin over it at the point where it enters the wood. Then use the clothespin as a gage while boring the remaining holes.—R. M.

THIS RAZOR STROP CAN BE HUNG ANYWHERE

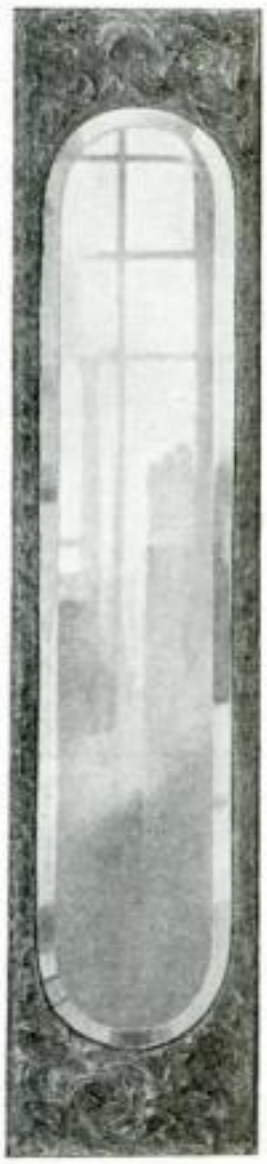


Razor strop improved by adding snap hook

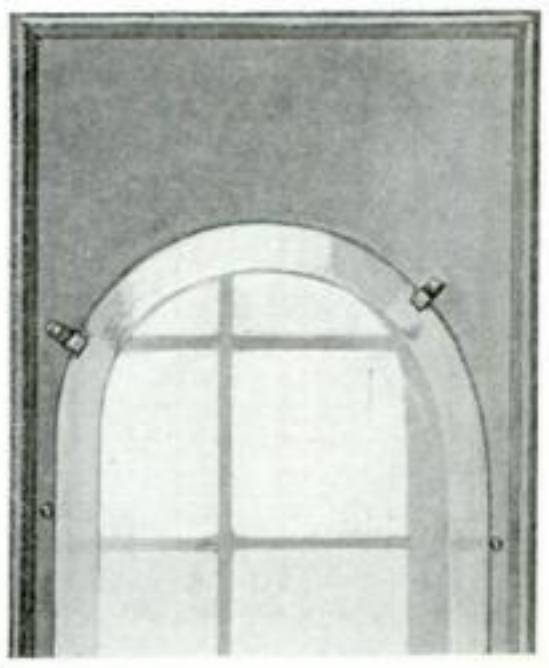
EVERY man who uses a strop to keep his razor blades in condition has experienced the aggravation of having to hunt for a place to hang up the leather when he is away from home. Rarely is there a special hook for the strop conveniently placed near the shaving mirror; and clothes hooks, towel racks, and all other bathroom fittings seem invariably to have a knob, head, or bracket which prevents the eye of the razor strop from being slipped over them. One simple way to forestall this difficulty is to attach a snap hook to the razor-strop swivel. The best type of hook to use is that illustrated, which is usually referred to as a small polo harness snap. It allows the strop to be attached anywhere.—F. B.

FRAMING AN OLD MIRROR ARTISTICALLY WITH PLASTIC PAINT

IN MANY an attic can be found an old mirror, the frame of which has been battered by years of service or has become completely outmoded. Such a mirror of odd shape was rejuvenated by securing it to a piece of plywood as shown in one of the photographs. Around the edge of the board were tacked pieces of ordinary window screen molding. Over this wood foundation a coat of paint with a little screened sand in it was spread and allowed to dry hard. Then the whole board around the mirror was covered with plastic paint. Any prepared plastic paint sold by paint stores may be used, or a good flat wall paint will serve if it is thickened by the addition of dry whiting. Ivory, cream, or white makes a good ground color. The paint should be applied thickly and brushed hard to insure good contact with the wood. The texture shown was obtained with a 2-in. paintbrush used in a circular manner to pull the plastic paint up to points in high relief. A putty knife was used to shape the plastic paint around the mirror. When the plastic paint was dry, a coat of raw umber oil color, thinned with turpentine, was spread on the surface, but any desired color of flat wall paint or mixture of oil colors may be used. Let the color set a few minutes and wipe off the surface with a cloth to give highlights and to obtain a polychrome effect if several colors were spread on the surface.—F. N. V.



An old mirror in a modern frame



Four metal clips and a few wood screws are used to hold the glass against the plywood

Copyrighted material

VALUABLE IDEAS *for* Auto Workers

OF THE common mistakes most motorists make, leaving the car with the ignition switch turned on and attempting to start with the emergency brake set head the list. Ideas to warn against these lapses of memory have appeared on this page before. Here is a single indicator light that serves both purposes. Note the arrangement in Fig. 1.

Any kind of colored glass indicator light is fitted to the dash. If the latter is of metal, the light should be insulated so that neither terminal is grounded. One terminal is connected to the wire that supplies current to the ignition circuit. The other terminal should be attached to the single contact of the grounded type of stop-light switch.

Fasten the latter at some convenient point to the metal framework under the floor boards in such a position that a piece of strong wire or chain can be attached to the emergency brake linkage. Adjust it so that the switch is closed when the brake is on.

When the car is standing with the brake set and the ignition switch off, the light will be out. When you turn on the ignition switch, the light will glow and will then go out again when you release the emergency brake. As it is quite unlikely that you will leave the car with the ignition on and the brake off, the single light will enforce the correct use of both.

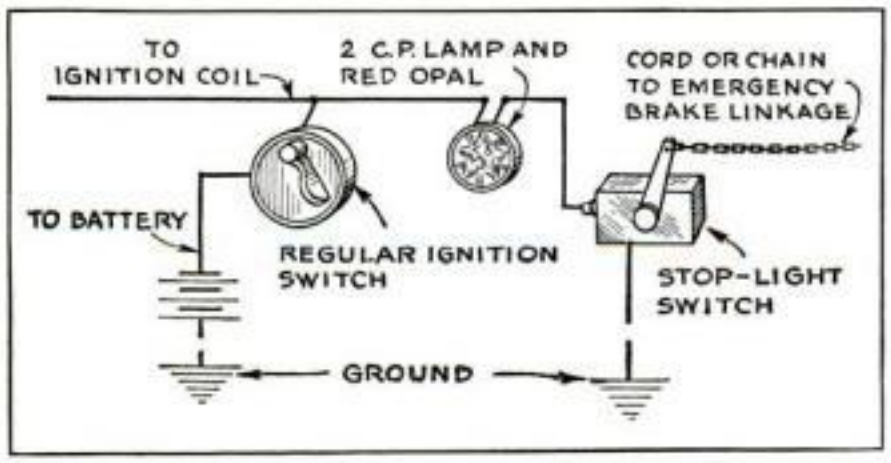


Fig. 1. Red light installed on the dashboard will warn driver against trying to start car with brake set or leaving it with switch on

A jewel light can be obtained from a radio store, or use the red glass jewel from an indicating type of wall switch.

Rear Seat Foot Rest

FIGURE 2 shows a simple type of foot rest that will protect the upholstery on the "short-coupled" type of coach. Strap iron brackets, shaped as shown, are attached to the underside of the front seats. The crossbar should be made of tough, hard wood. Grooves as deep as the thickness of the strap iron give the job a finished appearance, but a straight rod of wood or a section of iron pipe capped at both ends could be used.

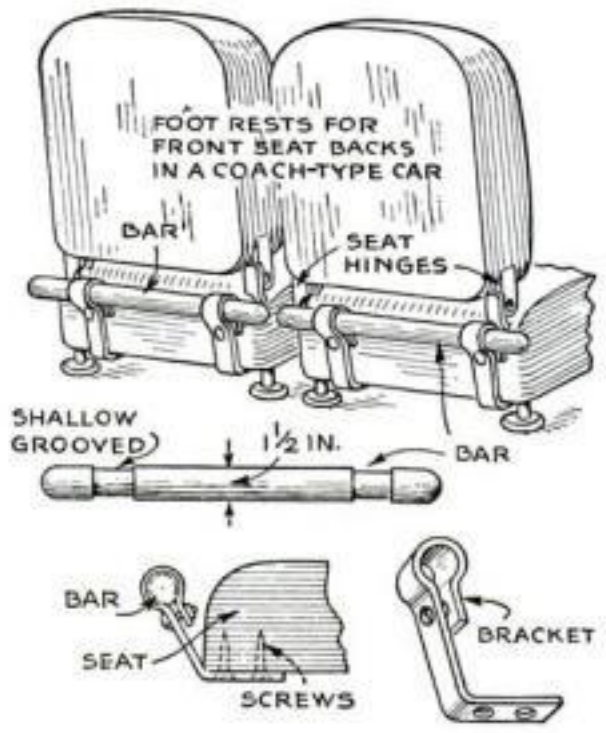


Fig. 2. Strap iron brackets, fastened to front seats in a coach, hold crossbar for foot rest

To Remove Carbon

THE usual method of cleaning the hard carbon deposit from the valve stems is by scraping after the valves have been removed. Figure 3 shows a way to do the job without removing the valves at all. A piece of clock spring should be bent as shown, with the edge curved on one end and the other fitted to any convenient type of handle.

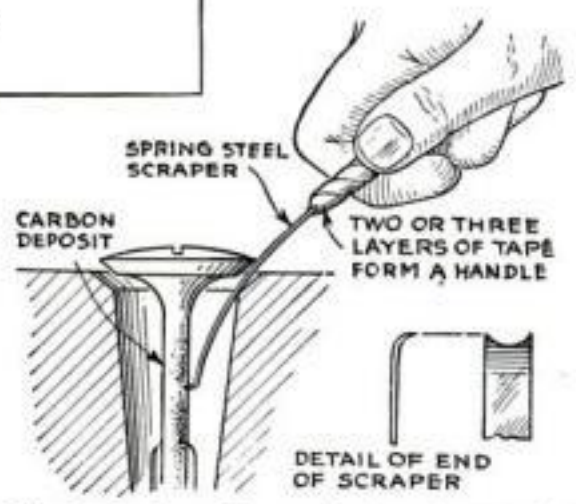


Fig. 3. A piece of bent clock spring can be used to remove carbon with valves in place

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to L. A. Griggs, Nanaimo, B. C. (Fig. 1). Contributions are requested from auto mechanics and if published will be paid for.

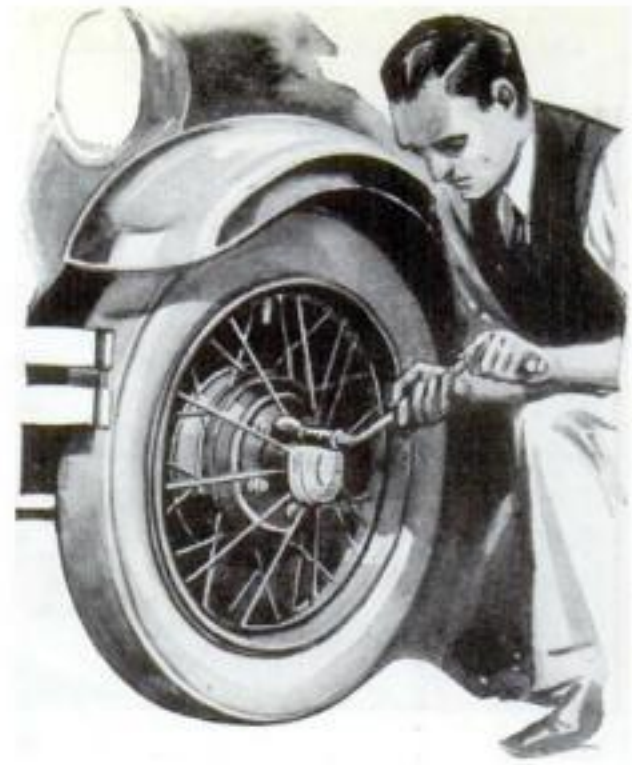


Fig. 4. Tire wrench won't knock enamel off wire wheels if a piece of rubber is wound around it

After the carbon has been scraped from the cylinder head and the tops of the pistons in the usual way, turn the motor over so that No. 1 exhaust valve is open, then scrape the valve stem as shown and repeat for the other cylinders. The inlet valves need not be scraped as carbon rarely forms on them.

Protect Wire Wheels

WIRE wheels are strong, light, and good looking, but they are a nuisance to clean. It is still harder to keep them looking well if the enamel is chipped off. Many cars are fitted with wire wheels fastened to the hubs by means of six or more bolts.

In changing tires, the steel wrench is sure to knock off some of the enamel unless the end of the wrench is covered with rubber. A section of inner tube wrapped around the end of the wrench, and held in place with rubber bands cut from the same scrap tube, will save the spoke enamel as shown in Fig. 4.

Flashlight Holder

A GOOD flashlight should be part of the equipment of every motorist. However, the common practice of tossing the flashlight into the tool kit usually results in a flashlight that is out of commission just when you need it most. Figure 5 shows a convenient way to mount the flashlight on the steering column, where it is handy and yet out of the way.

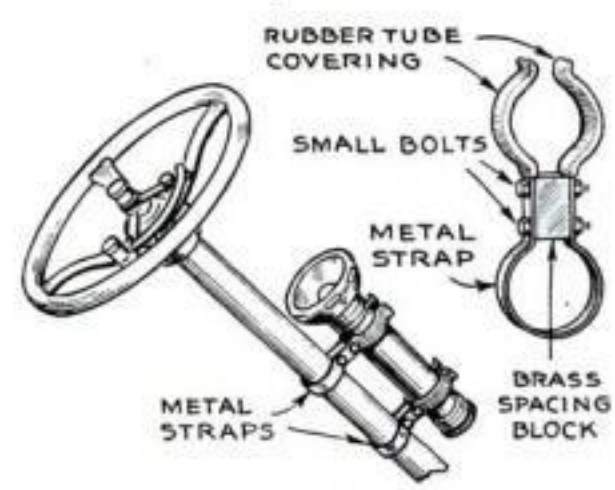
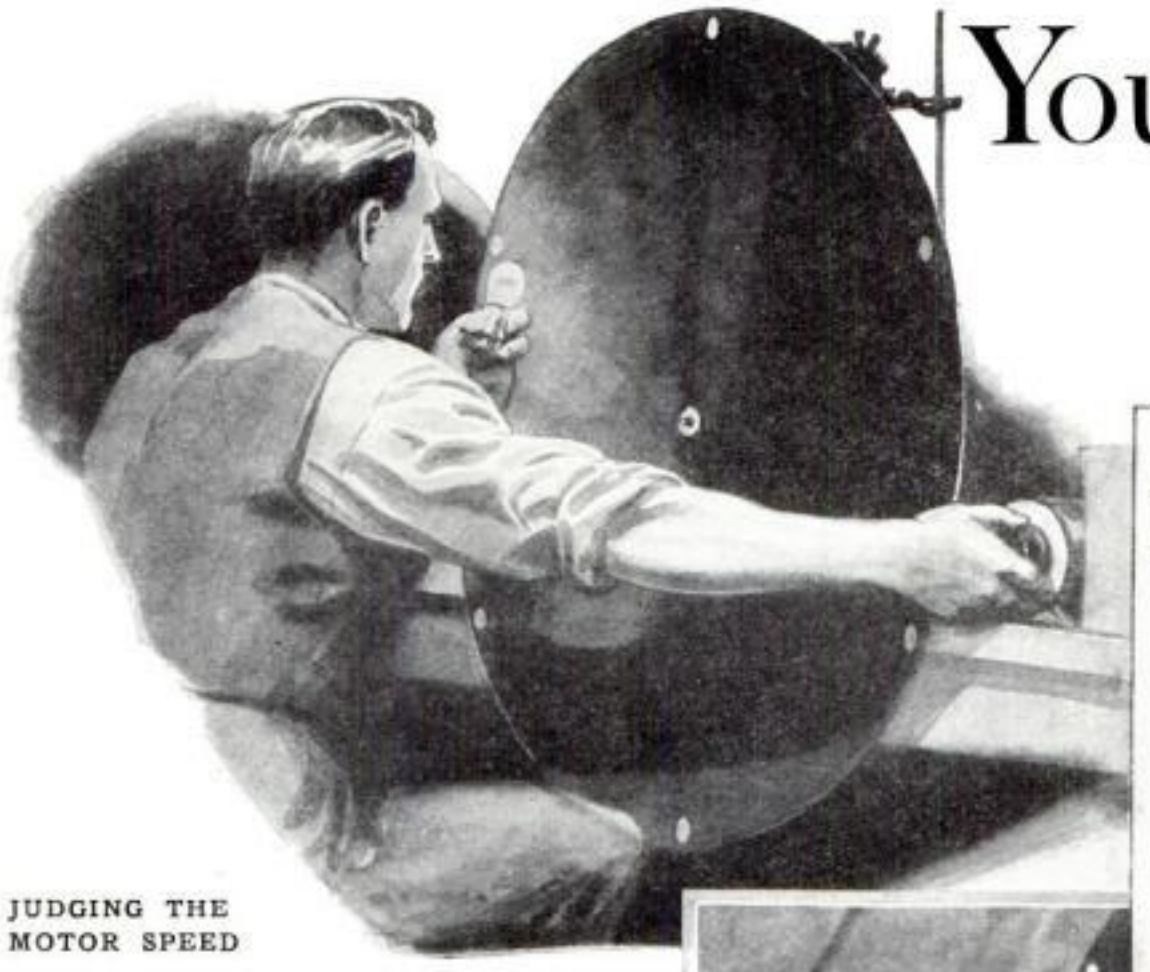


Fig. 5. To keep your flashlight in good condition, mount it, as shown, on steering post

Copyrighted material

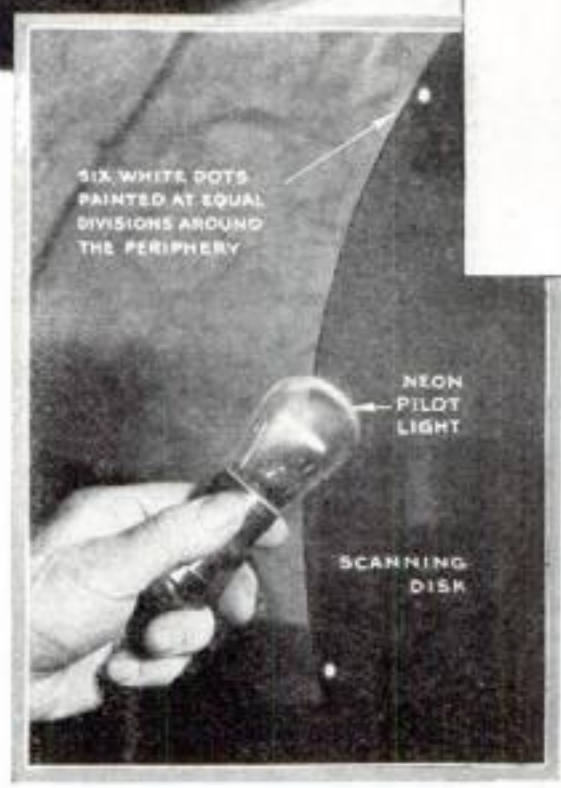
Don Marshall *tells* How to Control

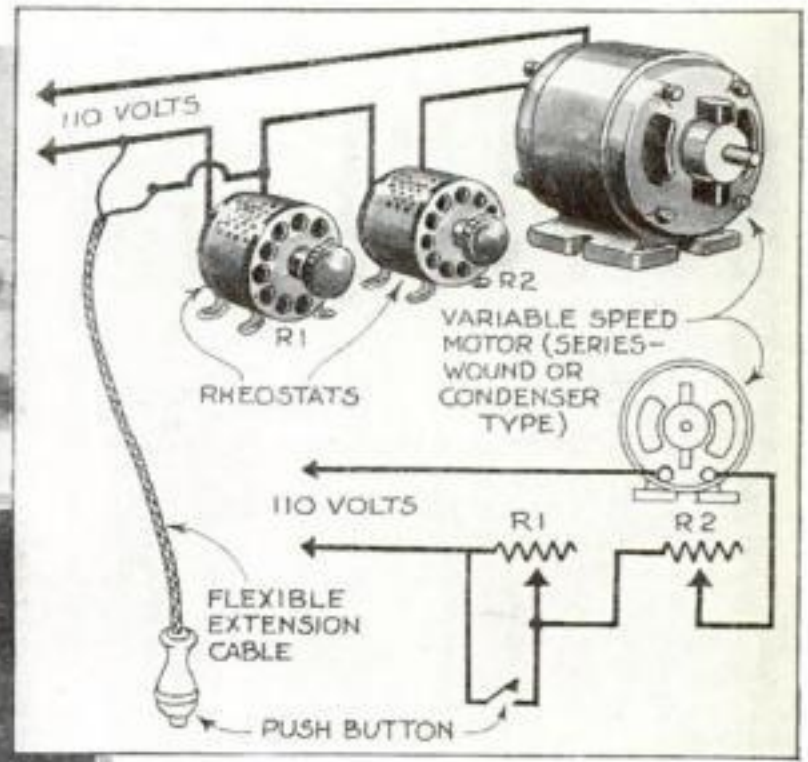
Your Television MOTOR



JUDGING THE MOTOR SPEED

A flickering neon lamp and dots on the disk simplify the problem of adjusting the speed





Picture diagram showing how rheostats are arranged on the push-button synchronizer

By

GEORGE H. WALTZ, JR.

"SOMETHING'S got to be done about it, Don," I said dejectedly as I tried to synchronize the disk of my television receiver by the "thumb method" previously described (P.S.M., Nov. '31, p. 88). "I've worn out three pair of garden gloves so far, not to speak of wearing the edge off my nerves. Can't I rig up something that'll keep the motor running at just the right speed?"

Don Marshall, radio expert and television experimenter, smiled. "I didn't think," he said, "you'd be satisfied with that crude method of synchronization after the novelty wore off. Why don't you use a synchronous motor; then when you receive the signals of stations located on the power line that supplies your motor, you'll have nothing to worry about?"

"Well, to tell the truth," I admitted, "I've been trying to get along with the equipment on hand. I thought maybe there was some way of connecting up this motor of mine to obtain synchronism."

"On commercial sets," Don replied, "they use a synchronizing device called a 'phonic motor'."

"A phonic motor?" I asked. "What is that?"

"Physically it consists of a toothed wheel which revolves between the poles of an electromagnet. In reality," Don continued, "it's a small motor that is run by an amplified portion of the received television signal. Since the toothed rotor is fastened to the shaft of the main driving motor, it serves to keep it in perfect step with the motor at the transmitter. In other words it's a speed regulator that is operated by the frequency of the television signal and serves to keep the driving motor in perfect synchronism with the station being received."

"Isn't there some way we can obtain practically the same result without going to the bother of building an additional motor?" I queried hopefully.

"A method which will work but will not be as good as the phonic motor," Don explained as he made the wiring diagram sketched above, "is to use a variable resistance that can momentarily be reduced by the operation of a push-button switch. By using two rheostats as shown in this sketch and supplying the first with a pendant type of push button, the decrease in resistance can be varied by altering the setting of the first rheostat."

"How does cutting down the resistance effect synchronization?" I asked.

"In this system you are just replacing your thumb with an electrical means of obtaining the same result. In use, the pendant push button is held in the hand of the observer, and when he notes that the image is slipping off to one side or the other, he operates the push button sufficiently to speed up the motor and cause it to revolve in synchronism again. Of course, the same method can be applied to a single rheostat," Don continued, "but the system using two variable resistances has the advantage that the resistance cut out by the push button can be altered if necessary to obtain just the right balance."

"In other words," I said, when Don had finished his explanation, "the motor is set at the proper speed and then held at that speed by reducing the resistance to speed it up just the required amount. I'll have to buy another rheostat and try it out."

"Of course," Don suggested, "if you want to, you can make a variable resistance by suspending two large lead plates and one smaller one in a tank of water acidulated with sulphuric acid. The push button is connected between one of the outside larger plates and the middle smaller plate. To vary the total resistance and alter the speed of the motor, it is necessary only to increase or decrease the distance between the two outside larger plates. The removable resistance can be altered by varying the distance between the end plate and middle plate. When the push button is operated, the resistance is cut down since the distance between the two terminals of the circuit is reduced."

"What do you mean by acidulated water?" I asked.

"Acidulated water," Don proceeded to explain, "is water to which a small amount of acid has been added to increase its electrical conductivity. The quantity to be added can best be found by filling the tank you intend using with water and adding the sulphuric acid drop by drop until the conductivity of the solution reaches a point where moving the plates apart or

Copyrighted material

nearer together materially affects the speed of the driving motor."

"Mentioning speed reminds me of something else I wanted to ask," I said. "Isn't there some arrangement I can use that will tell me when the motor is revolving at just the right speed of twelve hundred revolutions a minute? Between trying to synchronize the disk manually and recognize the proper speed visually, I've had so much to do when I try to operate this set that I haven't had time to enjoy the image."

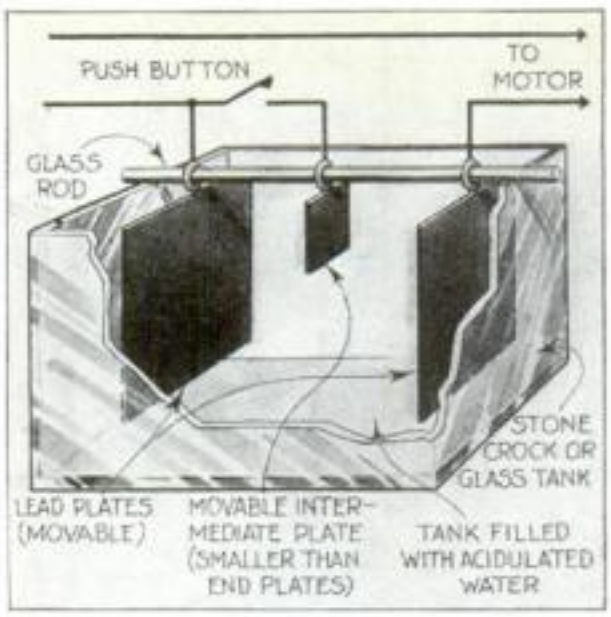
"Have you ever heard of a stroboscope?" Don asked.

"The name sounds familiar," I admitted. "It seems to me that it has something to do with moving machinery."

"Partly so. A stroboscope," Don began, trying his best to choose simple words and phrases, "is nothing but a flickering light that keeps time with the turns of a revolving object in such a way as to illuminate it at the same instant during each revolution. If a revolving wheel, let us say, is illuminated at the same time in every revolution, it will appear to be standing still, so a stroboscope is really an arrangement that allows us to make moving parts appear to be standing still."

"It all sounds very nice to me," I interrupted jokingly, "but what has the stroboscope got to do with television?"

"JUST this," Don replied. "By applying this to a scanning disk, we can tell when it is revolving twelve hundred revolutions a minute. If a neon glow lamp of the pilot light type, costing about seventy-five cents, is connected to the one-hundred-and-ten-volt, sixty-cycle alternating current supply, it will fluctuate from full-on to full-off one hundred and twenty times a second. The proper speed for the disk is twenty revolutions a second, just one sixth of the value for the fluctuations of the neon lamp; so if six dots are placed at equal divisions near the edge of the disk, they will appear to stand still when the disk is rotated at just the right speed and the spots are illuminated by the fluctuating neon lamp. You see, this gives us an ideal method for obtaining the proper speed. All we have to do is hold the small neon lamp close to the disk and increase the speed until the dots appear to stand still. The speed has to be right then, since only the proper speed will produce the effect."



A water resistance with movable plates can be used instead of the rheostats if desired

"Why can't I use the television neon lamp for this?" I suggested. "Then I could connect it up with a double-pole, double-throw switch in such a way as to allow me to switch into the one-hundred-and-ten-volt supply or the receiver."

"You can do that if you want to," Don agreed, "but I'd suggest using the cheaper type of pilot neon lamp; then if anything goes wrong you'll be out only half a dollar or seventy-five cents. You can screw the neon lamp into a hand socket."

"Let's see if I've got it right," I said. "First, I adjust rheostat number two until the dots appear to stand still under the illumination from the neon lamp connected into the one-hundred-and-ten-volt A. C. supply. Then I watch the image being formed and synchronize by operating the pendant push button held in my hand. If I need any further adjustment to obtain synchronism, I can obtain it by altering the resistance of rheostat one."

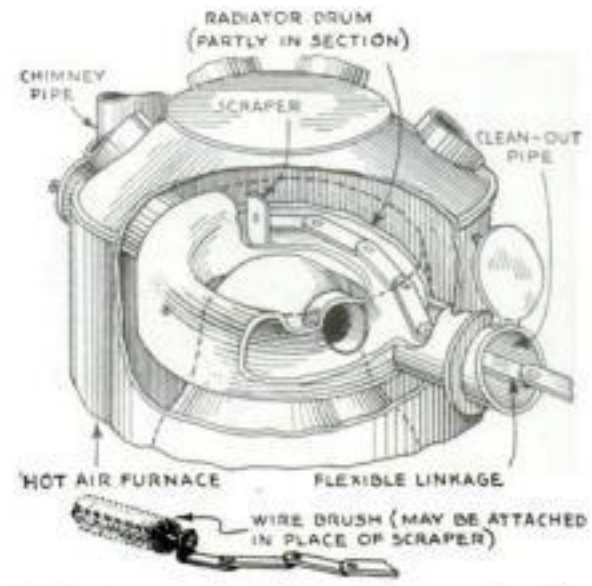
"That's right," Don said as he prepared to go. "Let me know how it works out."

Next month Mr. Waltz will continue this informative series of articles telling of an amateur's experiences in television.

FLEXIBLE SCRAPER AIDS IN CLEANING FURNACE

EVERY owner of a warm air furnace, whether of the pipe or pipeless variety, knows how difficult it is to remove soot from the circular radiator flue above the fire pot. This can be done easily, however, with the jointed cleaning device illustrated below.

When this long scraper is pushed into the small clean-out door, the joints adapt themselves to the curve of the radiator drum. Then by bearing down and pulling, you can remove all the hard, encrusted soot, pulling it out through the clean-out door.



Broken-away view of hot air furnace showing how the flexible handle conforms to curves

The materials required for making the furnace cleaner are 6 ft. of ⅛ by ¾ in. wrought band iron, 1 doz. 3/16 by ½ in. rivets, and a small piece of heavy metal for the scraper. A wire furnace brush also can be attached to the flexible handle when desired in place of the scraper. Cut the band iron into 6-in. pieces. Bend one of the end pieces to a right angle so that the scraper can be fastened to it. After assembling, apply oil to the joints and work them in a criss-cross fashion until fairly flexible.

When you have finished, be sure that the clean-out door is put back in place and fastened.—CHRISTIAN E. MARX.

NOW READY . . . Your Copy of the

1931 Home Workshop Annual INDEX

To take advantage of this special offer, fill out and mail this coupon immediately. If you wish the 1930 Index also, inclose twenty cents.

POPULAR SCIENCE MONTHLY,
381 Fourth Avenue, New York, N. Y.

Please send me the 1931 Home Workshop Index, for which I inclose ten cents.

Name .....

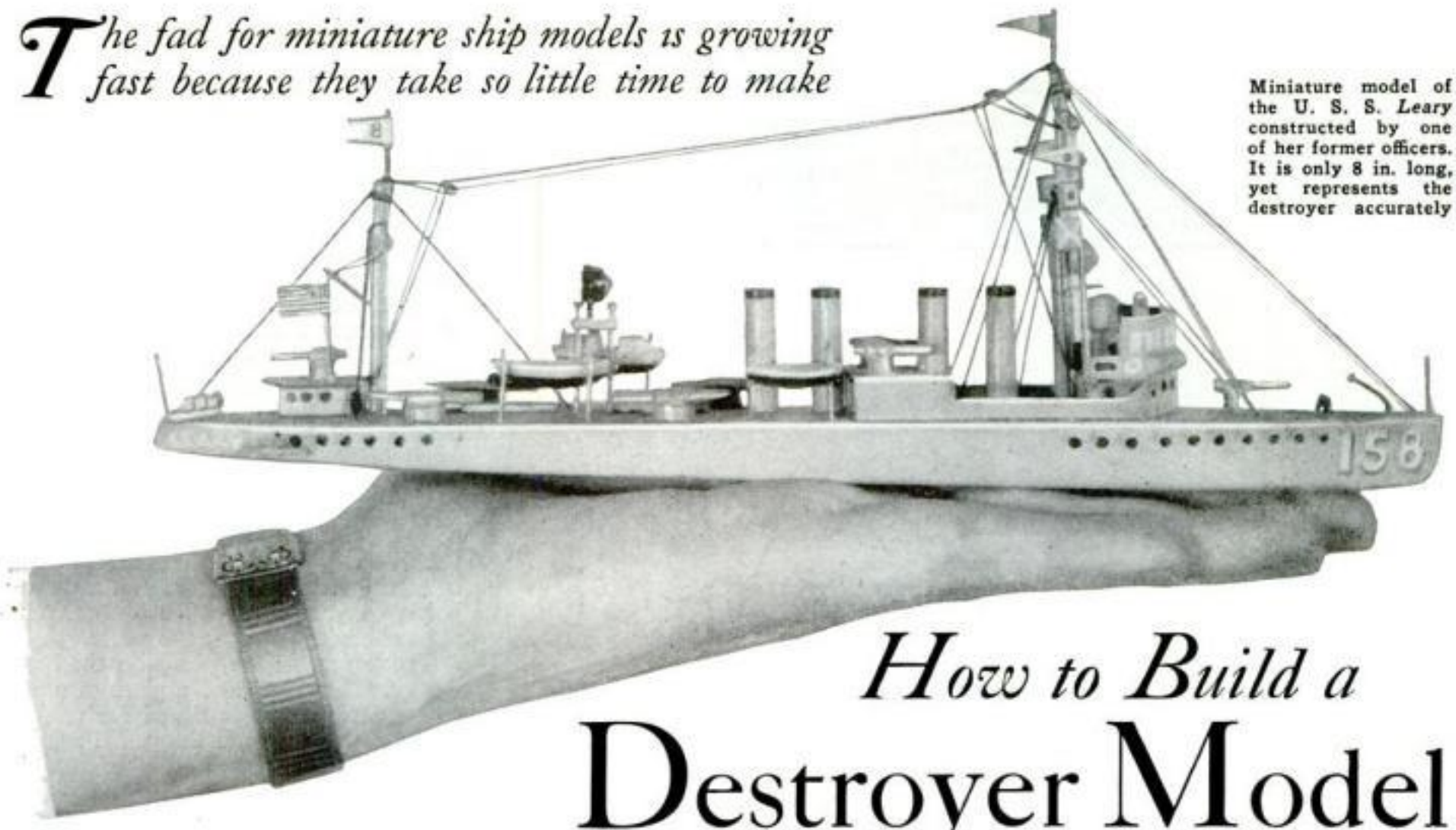
Street .....

City ..... State .....

THE 1931 index of the Home Workshop Department is now ready and will be sent to any reader for ten cents to cover the cost of printing and mailing. It is a completely itemized list of all the material published in this department during the past year. If you make a practice of saving back issues, as so many readers do, this index will enable you to find instantly any article to which you wish to refer. It really places at your disposal for ready reference a mass of information scattered through twelve issues and equivalent to a book of at least 700 pages—the finest and most up-to-date material of its kind. Thousands of readers took advantage of last year's offer and sent for the 1930 Index, which had to be reprinted to supply the demand. To avoid delay, fill out the coupon at once.

Copyrighted material

The fad for miniature ship models is growing fast because they take so little time to make



Miniature model of the U. S. S. *Leary* constructed by one of her former officers. It is only 8 in. long, yet represents the destroyer accurately

How to Build a Destroyer Model

HARDLY BIGGER THAN YOUR HAND

By Lieut. A. R. McCracken, U. S. N.

Formerly Gunnery Officer, U. S. S. *LEARY*

No matter how small is the apartment you live in, you can indulge in the hobby of model making and obtain just as good results as does Lieutenant McCracken. The only place he has to work is at his desk in an officer's stateroom on a destroyer—and no one has a smaller shop than that

SPACE aboard a destroyer is so limited that this model of the U. S. S. *Leary* (No. 158) had to be built on a miniature scale. All the work was done at a small desk provided in an officer's stateroom on the *Leary*.

The blueprints of the U. S. S. *Preston* published by POPULAR SCIENCE MONTHLY (see page 110) were used as a basis, the principal difference being that the *Leary* carries a motorboat at the port davits instead of the boats shown on the blueprints. The dimensions on the blueprints were reduced to one quarter. It will interest those who built models of the *Preston* to know that when that destroyer was placed out of commission, the officers and crew were transferred to the *Leary*.

If a water line model of the *Leary* is made, the carving will be reduced to a minimum, and no templates need be used. The hull is a slip of pine cut to the outline of the main deck. You can choose your own length of hull, provided you keep the proportions reasonably correct. The drawings at the bottom of page 86 are full size for a 7-in. model. I made my model slightly larger—about 8 in. long, ½ in. thick at the bow, and ¼ in. thick at the stern. A slight hollowing of the sides of the bow and a slight rounding at the lower part of the stern complete the necessary carving. Smooth the hull with sandpaper.

HOLES are drilled for masts and stacks, which are wooden dowels of appropriate size. With the stacks in place, paint the entire assembly gray. When dry, paint the tops of the stacks black, also the band around the tops. The ports, too, are painted black. The numerals and name are in white. Because of lack of space, the small numerals are omitted at the stern.

Each propeller guard is a bent pin, with a central brace made of wire running through a hole drilled completely through the hull from side to side. Jack staff and flagstaff are pins with heads cut off. The anchor davit is a bent pin with the head retained to represent the davit head and block. A piece of celluloid knitting needle is shaped to represent the winch and secured to the deck with a pin through it. Paint the winch black.

Just forward of the winch, cut a notch on each side of the deck to represent the billboards. A black strip is painted along the inner edge of each billboard to represent the flash plates. No anchors were fitted to this model as their size would have to be about 3/16 in. long.

The deck structure is limited, but all essentials are included and most of them are shown in the sketches. Small blocks of balsa or pine are used for deck houses. Bridge deck, flying bridge deck, and after deck-house platform are of bristol board. The bridge and well deck structure, aft to and including the galley, is one piece of bristol board. Owing to the difficulty of getting at such small parts, most of them should be painted before assembly. Doors and ports are represented in black paint. The bristol board is left white to represent the bridge windows. The ring buoys and running lights are painted at the sides of the bridge. The spray-shield is of half-round wood, three pieces being fitted just below the bridge windows.

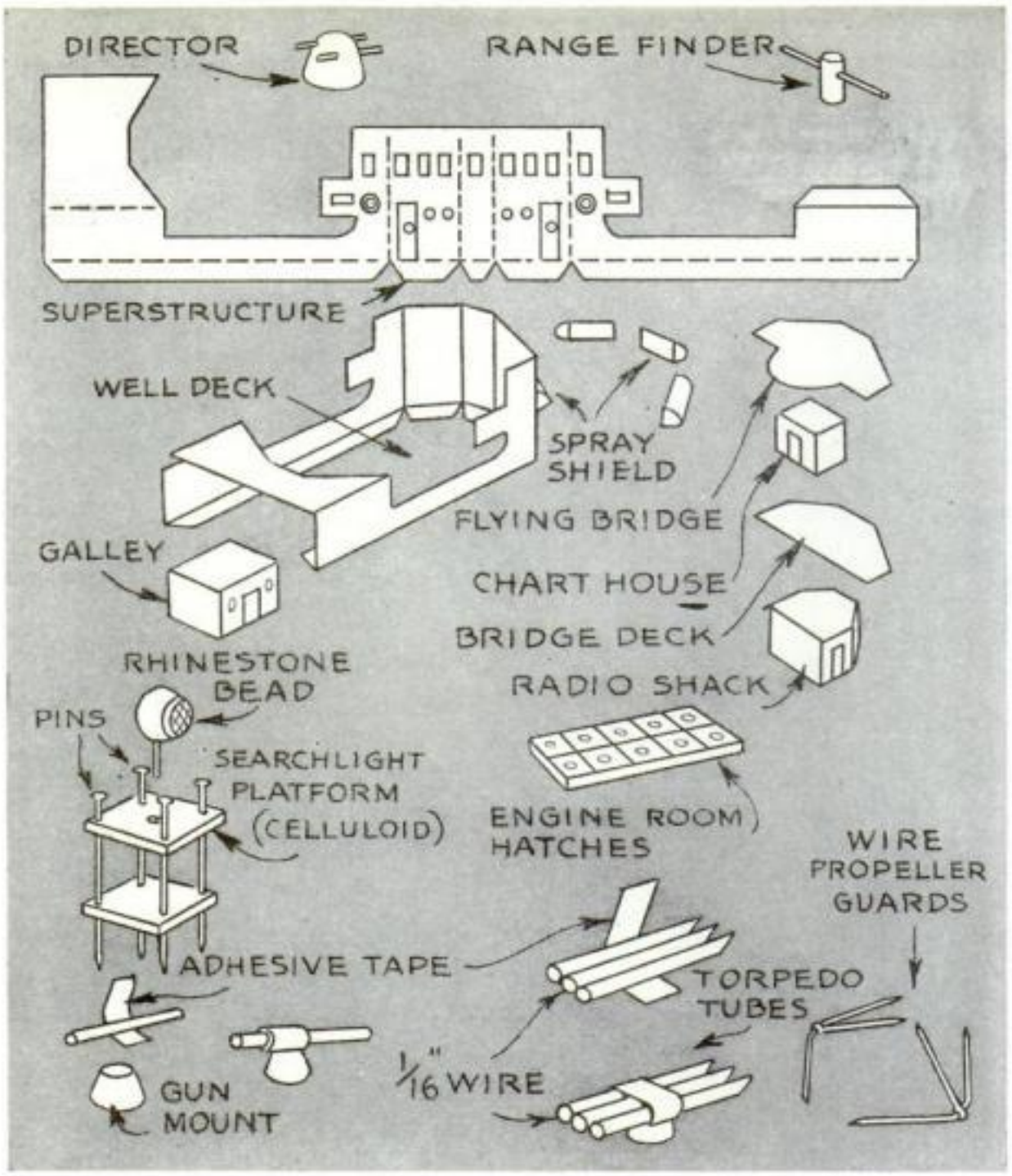
Guns are of 1/16-in. brass (or other metal) wire. A strip of surgical adhesive tape ⅛ in. wide is wrapped around the wire near one end, which becomes the breech. One layer of the tape is enough. Household cement will aid in keeping the ends from fraying. Gun mounts are made of wooden dowels. Taper the end of the dowel slightly, cut a shallow notch in the end, then cut off the mount to length. Cement the gun into the shallow notch. Paint the entire gun and mount gray, then cement it in its proper place.

THE same sort of construction is used for torpedo tube mounts. Three pieces of the wire are used, each 11/16 in. long. They are wrapped at the center with surgical tape, then cemented to a thin, flat slice from a dowel. The lower end of one end of the tubes is chamfered with a file as indicated—on the forward mounts at the forward end, and on the after mounts at the after end.

Depth charge racks are small slips of wood. Depth charges, popularly called "ash cans," are small pieces of dowel cemented in place on the racks.

Engine room hatches are of wood or

Copyrighted material



How the main deck structure is cut from one piece of bristol board, and sketches of other important details. For greater clearness, the small parts are shown on an enlarged scale

cardboard about 1/16 in. thick. Paint them gray, and mark them off into two rows of squares with a deadlight painted in black in the center of each square.

Boats are trimmed out of balsa wood with a small knife, which must be very sharp. Davits are soft copper wire, one continuous piece making both davits for a boat. Drill two slanting holes completely through the boat, and use the point of the knife to connect the lower ends of the holes with a small groove. Run the wire through the holes, pull taut until it lies flat in the groove, then shape the two ends into davits and cut off to length. The boats are black below the water line and gray above. The davits, which are gray, are inserted into small holes drilled in the deck. The whale boat is rigged out for sea (ready to be lowered at any time in case of necessity), and the other two boats are rigged in.

The searchlight platform is built up of two squares of celluloid and pins. The searchlights are rhinestone beads found at a ten-cent store. The shell of the forward searchlight is painted gray; the one on the platform is black. A fine wire through the hole in the bead provides means for mounting.

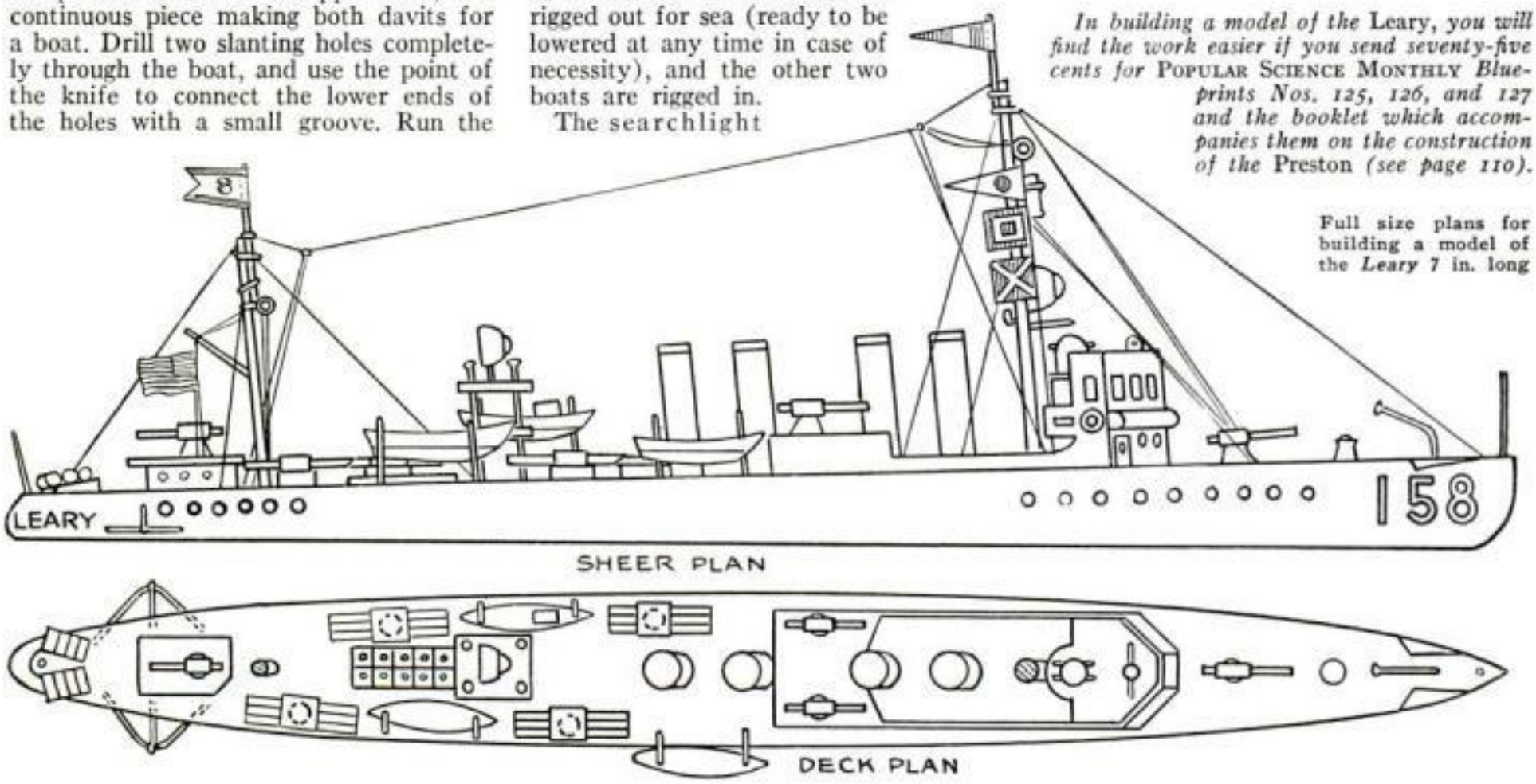
The crow's nest is a small section of round stick lashed near its top to the mast. When painted, the thread lashing gives the effect of the top covering.

Most of the stays are in pairs. A thread is tied about the mast and the two ends are led down, one to each side. The forestay and other single stays are fastened to the mast by using a slip knot. In securing lines of rigging to the deck, drill a small hole completely through the hull. Lead the thread through the hole and out the bottom. Dip a toothpick in cement and wedge it in the hole while holding the thread taut. Then snap the toothpick off and cut the thread flush. All stays are black, as is also the radio antenna. Signal and engine halyards are white.

The top masts are pins with the heads cut off. The gaff is also a piece of a pin; and, as this model is rigged for sea, the colors are flown from the gaff. Flags are made double; that is, a piece of paper is folded and creased and the flag cut out and drawn on both sides with appropriate colors. The under surfaces are then coated with cement, the flag is slipped over the halyard till it is back to the crease, and the two flaps are pressed together.

The *Leary* is the relief flagship of destroyer division eight, and the flags at the mastheads are those that are flown when she is actually being used by the division commander as his flagship. The one at the foremast is the unit guide; red, white, and blue sections (in order from hoist to fly). At the mainmast is the burgee of the division commander. It is swallow-tailed, white in color, with a narrow red band at top and bottom, and the numeral 8 in red in the center. The signal flags at the foreyard of this particular model are the international alphabet flags representing the initials of the person to whom it was presented.

In building a model of the Leary, *you will find the work easier if you send seventy-five cents for* Popular Science Monthly *Blueprints Nos. 125, 126, and 127 and the booklet which accompanies them on the construction of the* Preston *(see page 110).*



Full size plans for building a model of the *Leary* 7 in. long

Copyrighted material

Old Furniture Converted Into New

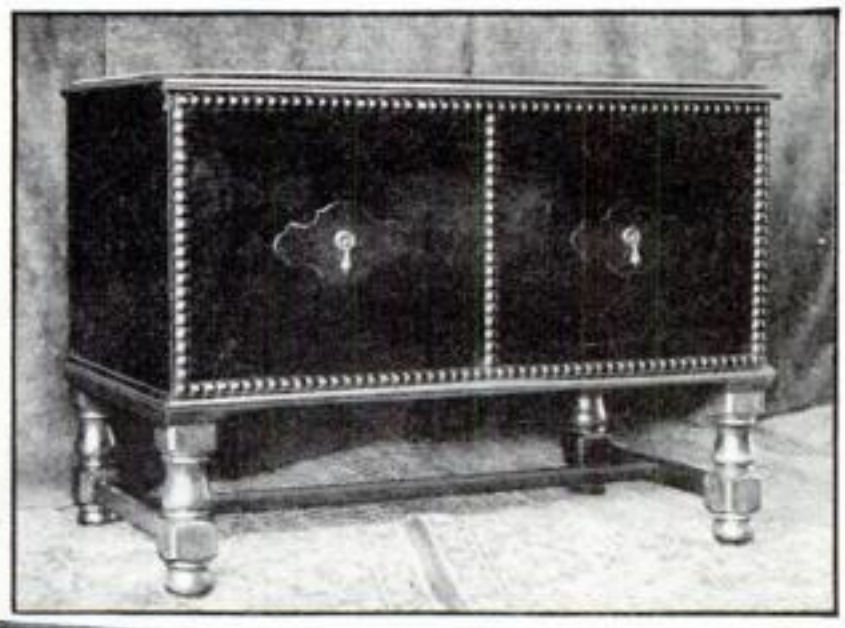


Fig. 1. A cedar-lined chest made from a discarded radio cabinet set on short turned legs in place of the high ones on which it stood in its original form

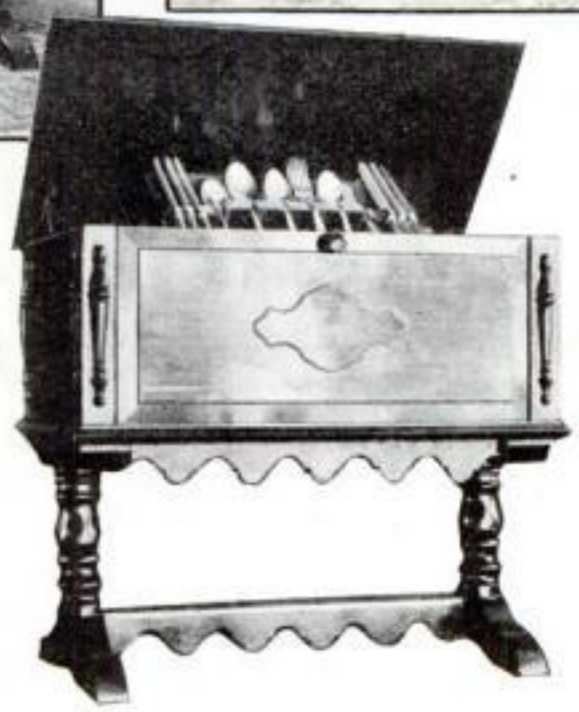


Fig. 2. A cabinet of the old table variety converted into a receptacle for storing linen and silverware. The front opens as shown above at the extreme left

Fig. 3. This night stand is an adaptation of a console cabinet of the smaller type

Fig. 4. Colonial corner cabinet constructed in large part from a beautiful but obsolete commode

MANY high-grade radio cabinets and tables have found their way to the discard heap because the sets they contained have been superseded. From these it is possible to create useful and attractive pieces of furniture at minimum expense. For example, the console type radio cabinet used for the old battery sets makes an ideal cedar chest (Fig. 1). I bought an excellent cabinet for $1.50, removed the high legs, and turned low ones of regulation chest height. Then I lined the chest with ⅜-in. cedar, put a molding around the front door openings, and applied ornamental overlays on the panels. A radio cabinet of the old table type with short turned legs may be converted into a container for silverware and linen as shown in Fig. 2. A shallow tray is built under the top lid for storing silverware, and the compartment beneath, which is accessible through a drop door, is used for linens. From a smaller console type cabinet, the night stand shown in Fig. 3 was made merely by removing the usual front piece and adding a drawer and a door. Other pieces besides radio cabinets may be used in the same way. From an obsolete but beautiful commode with handsome burl walnut panels, I constructed the Colonial corner cabinet illustrated in Fig. 4. This was done by raising it off the floor about 6 in. on turned legs, rebuilding the sides to fit snugly in a corner, and arranging shelves inside. Above this, I built a tier of shelves with a scroll-sawed front piece or frame. Large phonograph cabinets likewise can be easily transformed into useful pieces of furniture.—MADS S. MOLLER.

HANDY NAIL HOLDER MADE FROM CANS

BY MAKING a nail container like that illustrated, the home worker can carry an assortment of nails, screws, and other small items of hardware to wherever he happens to be doing a repair job. Seven round cans of uniform size are required —for example, 1-lb. putty cans. Place them together on a piece of ½ in. thick board, draw a line about ¼ in. outside of them, and saw out the base. Fasten each box in place with two ¾-in. trunk nails and clinch the ends. Fit two ¼ by 6 in. carriage bolts through the bottom in spaces between the cans as shown, sinking the heads of each bolt flush with the underside. Bore a hole lengthwise through two ½-in. or thicker dowels about 4¾ in. long to slip over the projecting bolts, and make a handle ¾ in. in diameter with crosswise ¼-in. holes near each end to receive the bolts.—D. W.

Seven empty 1-lb. putty cans mounted on a board to form a holder for nails and screws

TREATED CONES BLAZE WEIRDLY IN FIRE

FAIRY pine cones which will emit weird, velvety blue-green flames for five or ten minutes when thrown into an open fireplace can be prepared by rubbing them with a mixture of three or four parts of copper chloride crystals and one part, by bulk, of plaster of Paris, wetted until the mass becomes creamy. To treat a large quantity of cones, merely soak them in a solution of about half a pound of copper chloride to a gallon of hot water in a wooden pail. Let them dry thoroughly before use.—R. WAILES.

Copyrighted material

A Sewing Cabinet

of MODERN DESIGN

By
E. C. Wittick

THIS sewing cabinet, although it has turnings and legs typical of the Tudor period, is of modern design and combines beauty with ease and novelty of construction—features that should appeal to any home woodworker.

The materials needed are as follows: 2 legs 1½ by 1½ by 30⅛ in.; 1 stretcher and 1 handle 1½ by 1½ by 10¾ in.; 2 feet 1½ by 2½ by 12 in.; 4 sides ¾ by 7¾ by 11 in.; 1 bottom ¼ by 10¼ by 10¼ in.; 2 lids 11/16 by 4 11/16 by 11⅜ in.; 1 centerpiece ¾ by 2 by 11 in.; 1 tray bottom ¼ by 4¼ by 9 in.; 2 tray sides ¼ by 2 by 9½ in.; 2 tray ends ¼ by 2 by 4¼ in.; 1 tray partition ¼ by 1¾ by 9¼ in.; 1 tray partition ¼ by 1¾ by 2¼ in.; 2 runners for the sliding tray ½ by ½ by 9½ in.

Bandsawing one of the feet. By using the inch squares in the drawing, the shape can be sketched full size

Only relatively simple woodworking operations are required in the building of this portable sewing cabinet

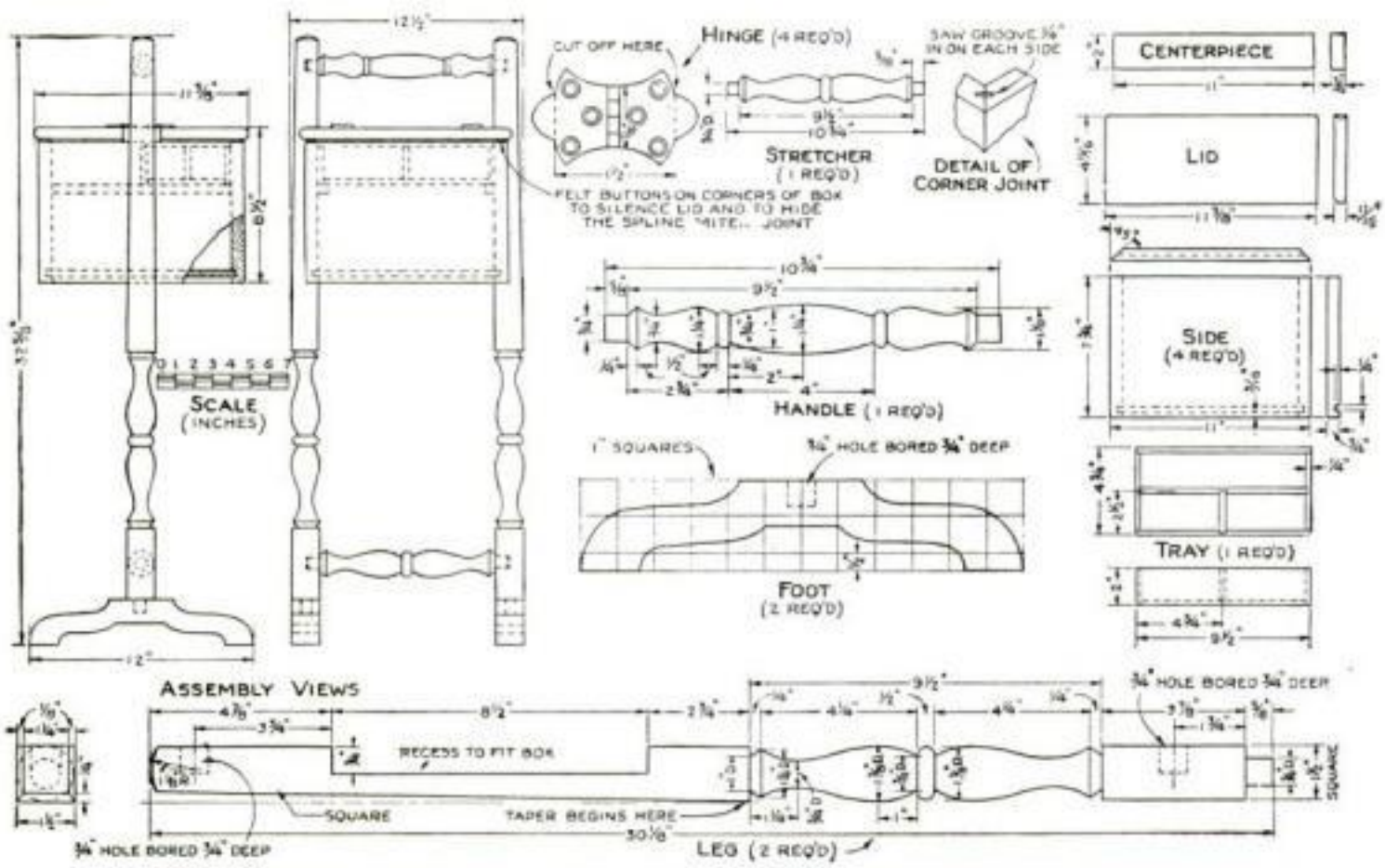
Red gum was used for all except the bottom, which is fir plywood, but any cabinet wood such as walnut or birch may be chosen. The sizes given are exact, and allowance should be made for finishing.

Turn and bore the legs, but leave the recess until the box parts have been made. Then turn the stretcher and handle, and saw out the feet. If a circular saw is available, use the spline miter joint shown for the box joints; otherwise a simpler type of joint may be substituted. When the finished height of the box can be determined, cut the recess in the legs to fit exactly. Next taper the legs by hand planing them, and round the tops by filing.

Assemble the pieces first without glue; then make and fit the splines (thin strips of wood). Glue one box side to each leg and nail from the inside. With one leg and side lying on the bench, inside face of box up, apply glue and fasten the handle, centerpiece, bottom, stretcher, and foot; and glue the foot on the other leg also. Apply glue to the upturned ends of the cross bars and centerpiece and put the other leg in place. Clamp all securely and stand the cabinet on its feet so that they can be lined up properly. Have the splines ready and covered with a thin coat of glue; then apply glue to the miter joints and grooves, put the two remaining sides of the box in place, and clamp.

The brass hinges should be cut off as shown, but before mounting them glue a felt button on the top edge of the box at each of the four corners to silence the lid and hide the spline miter joint.

The original cabinet was stained walnut, shellacked, sanded lightly, and given four coats of high-grade furniture varnish, each coat being rubbed down. Some of the stain on the bulges of the turned parts was sanded off to make them slightly lighter in color than the rest to obtain artistic highlights which enhance the finished appearance of the legs, handle, and stretcher.



Assembly and detail views showing the construction of the cabinet. Ordinary brass hinges, cut down as indicated, serve to hold the two lids in place. Felt buttons glued at the corners of the box silence the lid

FLEXIBLE CONDUIT ACTS AS MACHINE COUPLING

IN AN emergency, when it is desired to direct-couple two small adjacent machines, a length of electrician's armored BX conduit with the wires removed can be made to serve as an efficient substitute for a regular flexible coupling. If the inside diameter of the conduit is not precisely the diameters of the shafts, it can be filed a trifle to fit, or the shafts filed to fit the conduit, as the case may be. Ordinary conduit couplings fastened at each end of the length of BX will serve to hold it firmly in place. The slight flexibility of such a connection will compensate for any unevenness in the running or slight difference in alignment which would otherwise evidence itself in poor operation. Of course, conduit used in this manner should be run in a direction which matches the twist of the spiral of the armored covering so there will be no tendency for it to be unwrapped.—L. B. ROBBINS.

Copyrighted material

TWICE A DAY TO PREVENT COLDS

We offer you this suggestion for the use of Listerine in the hope that it may spare you or members of your family an uncomfortable, costly, and possibly dangerous siege of illness.

From 50% to 66% Fewer Colds

Prolonged tests conducted under medical supervision on 204 persons in normal health uncover truths no sensible person should overlook. Standing forth is Listerine's remarkable ability to *prevent* colds. And to lessen their severity.

They prove that those who gargled with full-strength Listerine *twice* a day contracted only half as many colds—and in some cases one-third as many colds—as those who did not gargle at all. A reduction between 50% and 66%!

When colds *did* develop among Listerine users, they lasted only one-third as long and were one-quarter as severe. Bear that in mind.

Ordinary Mouthwashes Fail

Such performance, of course, could not be expected from harsh mouthwashes which, by irritating the tissue, allow germs easier entrance. Nor could they be expected from weak, watered imitations of Listerine often devoid of any germicidal power whatever.

Only full-strength Listerine, under clinical tests, has shown such preventive action and curative effect.

Effective Because Safe

Such amazing results are due to the fact that Listerine kills germs in the mouth in the fastest time *without injury to tissue.* Unlike that of harsh mouthwashes, its effect is actually healing.

So, while Listerine attacks the cause of infection, it remedies the swelling, irritation, and inflammation that accompany it.

Be Systematic

Make a habit of gargling full-strength Listerine every morning and every night. Thus, you keep your breath beyond suspicion and help Nature to ward off colds and sore throat.

Once a cold threatens to become serious, increase the frequency of the gargle to once every two hours, meanwhile calling your doctor. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

LISTERINE effective because SAFE

Copyrighted material

Hints on Getting Longer Service from

Costly Machine Shop Tools

By HECTOR J. CHAMBERLAND

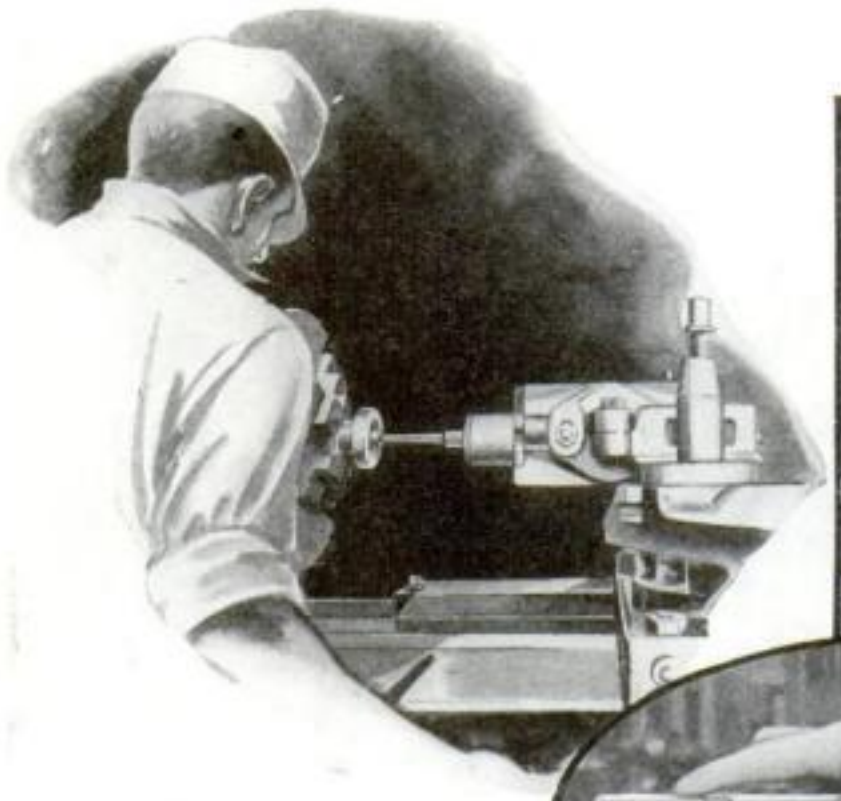


Fig. 2. To grind stellite internally a high-speed spindle is essential

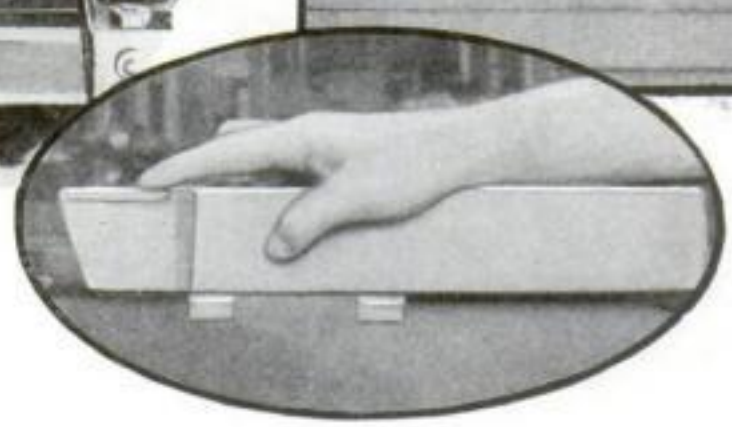


Fig. 3 *(oval)*. This lathe tool has a $50 insert of tungsten carbide

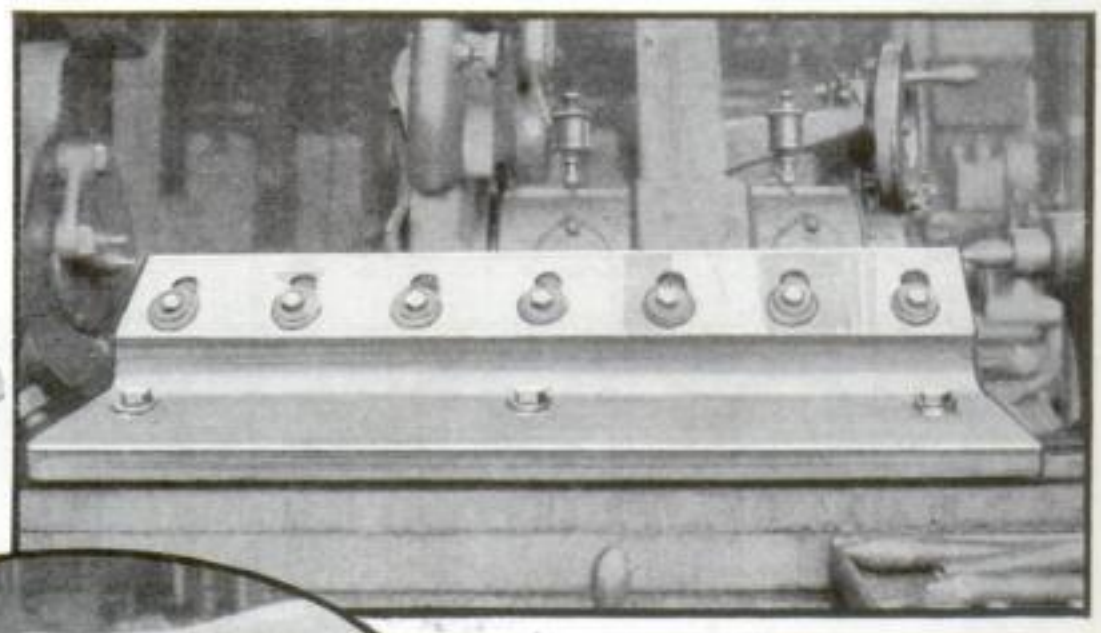


Fig. 1. A fixture for holding planer knives while being sharpened on a regular grinder

SO MUCH money has to be spent by every up-to-date machine shop in purchasing high-grade tools of one kind and another that their proper maintenance is a subject with which every machinist must familiarize himself. He must know how these costly tools can be kept in condition to do their best work for the longest possible time.

Many small shops, for example, have woodworking departments for which the planer knives have to be kept in tiptop shape. In every large plant will be found a regular planer knife grinding machine, but where a set of knives has to be ground only about once a week, a plain grinder answers the purpose as illustrated in Fig. 1. The necessary grinding fixture is detailed at *A* in Fig. 4.

While the regular machine uses a cup wheel which gives the angle a straight cut, the slight concavity caused by using an ordinary 10-in. wheel will in no way affect the working qualities of the knives, although it must be admitted that the cutting edge is slightly weakened.

The wheel used should be no harder than grade J and the grain no finer than 36; in fact, any soft and open-grain wheel will do, providing the cutting surface is no wider than ½ in. as indicated at *B* in Fig. 4, and a heavy flow of grinding compound is used. After being ground, the cutting edges should be stoned slightly.

Even if made from a new casting, the fixture is inexpensive; and it often may be made still more cheaply from some piece of junk salvaged from the scrap pile. There are many makes of planer knives, and the width and location of the screw slots vary, so the location of the tapped holes on the grinding fixture have not been given any spacing dimensions. The fixture is long enough to accommodate the average run of planer knives.

Because of their extreme hardness, tools made of stellite require to be ground on machines that are in the best condition. No satisfactory results may be expected with worn-out equipment. The smaller shops make a practice of buying such tools in the form of the finished product, and this is undoubtedly good judgment.

For turning and forming tools in high-production shops, tungsten carbide tools are gradually coming into extensive use, but for making machine parts and tools such as valves, valve seats, and plug and ring gages, which must retain their accuracy to within the closest possible limits, there seems to be little chance that anything better than stellite will be offered for use in the type of shop to which these suggestions refer.

For grinding stellite, regardless of the operation, the grinding wheel should travel at its highest safe speed. For example, if a machine is designed for a 7-in. wheel, a 6-in. wheel will not work so satisfactory for stellite, whereas no difference in results would be apparent on high-speed steel. Alundum 60 H or its equivalent in a wheel with a ½-in. face is recommended for surface grinding. It is advisable to relieve the cutting surface so that no more than half of it will do any cutting. Not more than .0005 in. of stock should be removed at each feeding. The wheel should be re-dressed before taking the finishing cut.

For internal grinding, only a high-speed ball-bearing spindle will work correctly. Figure 2 illustrates the grinding of a stellite valve seat used in a dairy machine. The valve and seat are ground to match and then lapped to resist a pressure 50 percent higher than required. They are returned about once a year to the factory for refacing. Alundum 60 in a wheel ¾ by ⅜ in. is used. It is operated at a speed of 35,000 R.P.M. In a case of this kind, if no high-speed spindle is available, a harder wheel should be chosen.

If for any reason external cylindrical grinding has to be done on stellite, the regular wheel used for high-speed steel may be used, and three operations are necessary. Provided that the spindle bearings are in good shape and the wheel is operating at a satisfactory surface speed, the work should be rough-ground to within .002 in. of the required size. The wheel then should be re-dressed by making use of the automatic traverse feed. In connection with the finishing operation, it should be borne in mind that .0002 in. should be allowed for lapping if such a finish is required.

Except for the last operation, stellite tools are generally ground dry.

ALL that could be written about tungsten carbide would fill a handbook. It is, of course, supplied under several names, one of the most familiar to the average machinist and toolmaker being "carboloy." Its limited use for the present is for turning. Next to the diamond in hardness, it comes ready to use in the form of a very small piece or segment cemented to a soft steel tool holder. The only subject to consider here is how to grind the tools when they get dull so as to make the investment as profitable as possible. The side facing tool shown in Fig. 3 is used on crankshafts with three connecting rod bearings 6 in. in diameter. The rough stock comes in the form of

Copyrighted material

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS...See page 8

Copyrighted material

40 percent carbon steel billets, which means that an excessive amount of stock has to be removed to machine these parts. Two tools are required, one right- and the other left-handed. When high-speed steel tools were used before the introduction of tungsten carbide, these tools had to be reground once a day on the average, and the entire machining operation on one crankshaft required about six days. With the tungsten carbide tools, the machining time was cut to four days, and there are times when very little wear is apparent when the work is completed.

The cost of tungsten carbide is figured not by the pound, but by the ounce and even grams. The segment cemented to the tool illustrated (Fig. 3) is 3/16 in. thick, and the price paid was $50. From this figure, it was estimated that for each .005 in. of stock we have to remove by grinding, we depreciate the tool $1.35, or 27 cents for each thousandth. This simply means that money is going into dust very rapidly if unnecessary grinding is done.

Every manufacturer of grinding wheels today makes one especially for tungsten carbide. Any regular wheel would simply be dressed by the alloy as with a diamond wheel dresser. On the other hand, the special wheels for tungsten carbide are of little value for regular work.

When grinding these tools, the original rake must be noted and kept on record, as shown at *C* in Fig. 4, so that it may be duplicated at each grind. Note that the stock of the tool holder back of the segment has 2 deg. more rake than the segment itself; this is ground with the regular wheel and acts as a clearance when using the special wheel.

A tungsten carbide tool should never be allowed to get in such bad shape that the tool. When grinding, about .0002 in. is the correct amount of stock to remove, and this always should be done by working from the cutting edge.

Tungsten carbide, like a diamond, is very brittle and accidents will happen, especially when machining large castings. Should it so happen that a large segment chips too badly, it is advisable to return the tool to the factory to be salvaged.

This is the second of two articles on maintaining the more costly tools used in the average machine shop. Other articles by Mr. Chamberland are scheduled for early publication.

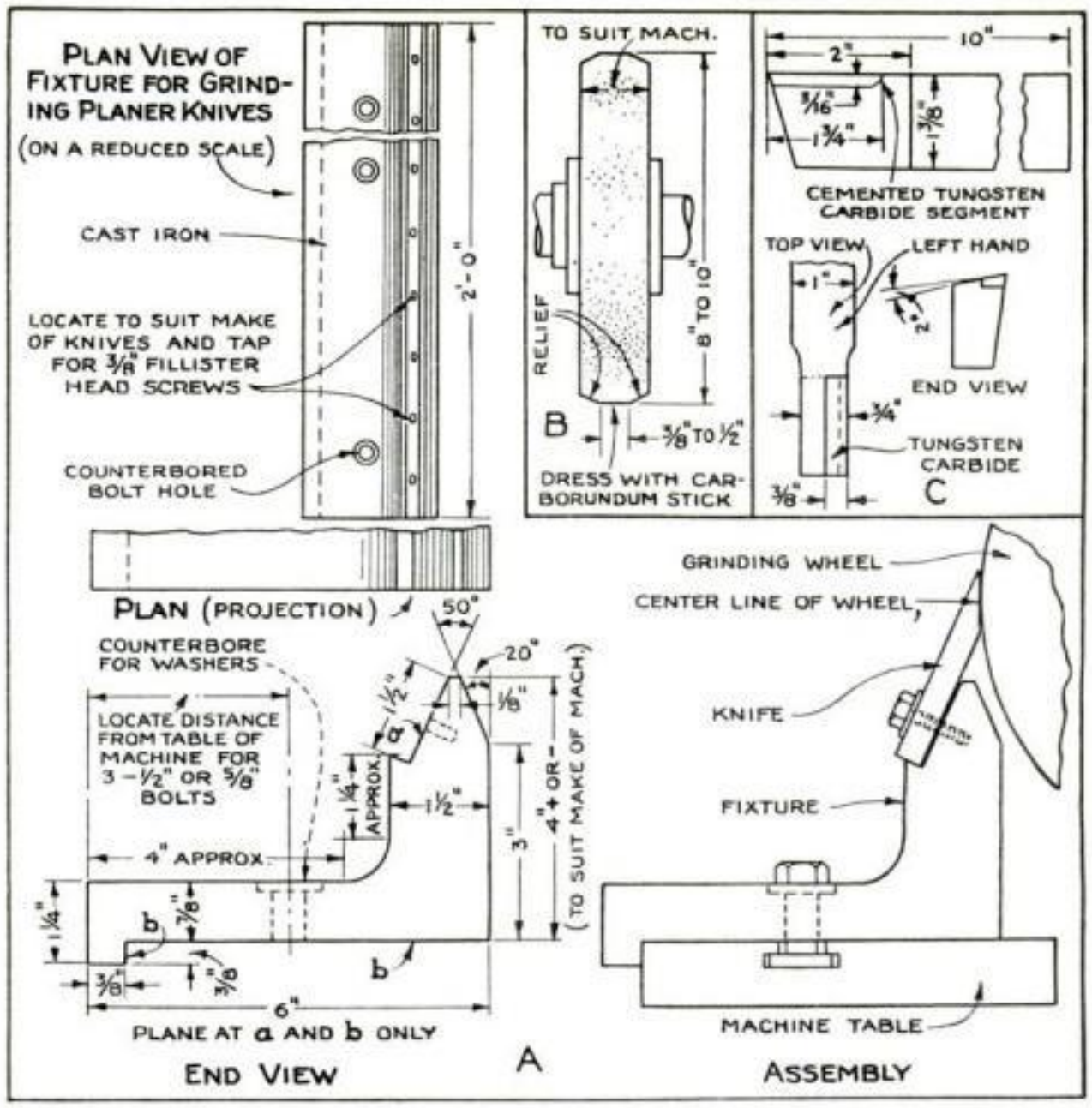
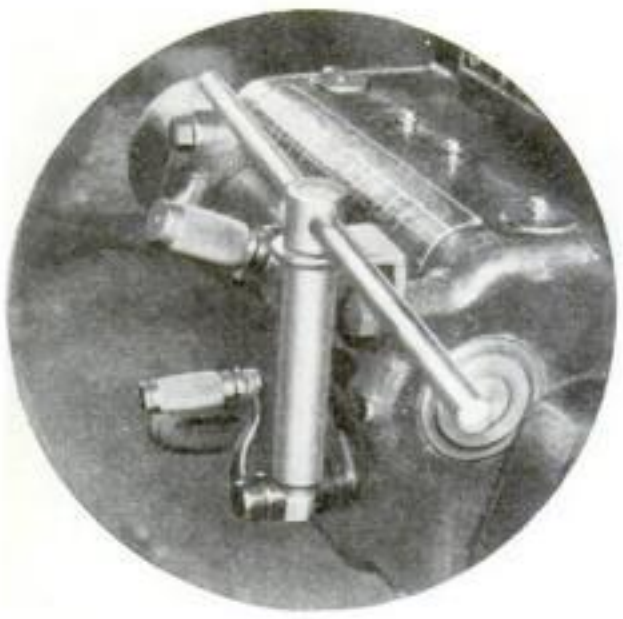


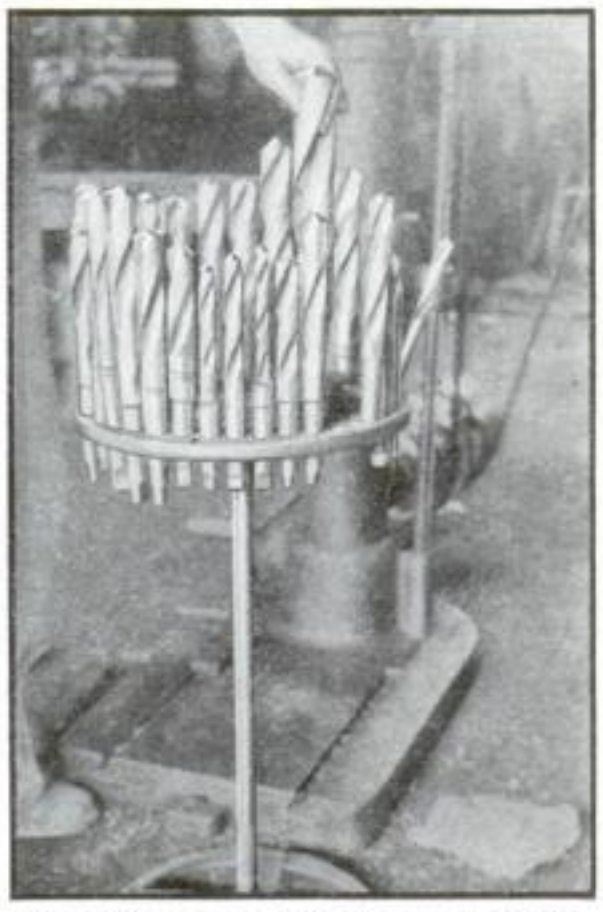
Fig. 4. End, top, and assembly views of a fixture for grinding planer knives *(A)*, how the wheel should be dressed *(B)*, and a lathe tool with a tungsten carbide steel insert *(C)*



HOLDER ON LATHE KEEPS CHUCK KEY HANDY

ANY machinist, when setting up a job on the lathe, appreciates knowing just where to find the key to the chuck. If a hole is drilled for the key in one flange of a 1½-in. section of 3 by 3 in. angle and the angle is bolted to the machine as illustrated above, the key is always out of the way and yet close at hand and ready for instant use.—C.L.E.

REVOLVING STAND FOR LARGE DRILLS



Placed beside the drill press, this revolving stand holds a large assortment of drills

THE revolving stand shown at the left is useful for keeping a variety of large twist drills handy at the press. It is made from a ring of metal, 16 in. or more in diameter and about 2 in. wide. Holes are drilled for as many bits as the ring will hold, and opposite each hole is stamped the size of drill it will accommodate. By means of two or more small studs, the ring is fastened to a disk of light metal. This is welded to a 2-in. section of tubing, which fits over the top of a 30-in. section of smaller tubing. The latter is welded at the bottom end to another disk or ring of light metal. Old steam pistons or other scrap metal around the shop may be utilized in making a stand like this.—JOSEPH C. COYLE.

CATCHING SHAPER CHIPS

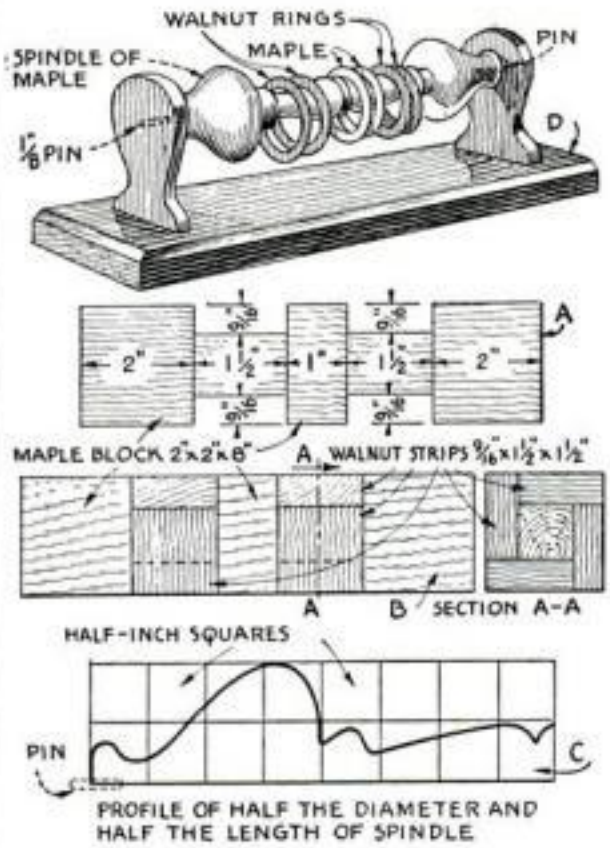
FLYING steel chips from a shaper are often such a nuisance that it pays to make a boxlike catcher for them about 16 by 16 by 16 in. with one side open. Mount it on a 1½-in. pipe; then fasten a 2-in. pipe to a heavy base and fit a set screw so that the smaller pipe can be raised or lowered as necessary.—F. J. W.

Copyrighted material

TURNING WALNUT RINGS ON A MAPLE SPINDLE IS CURIOUS TRICK

WOOD turners have an old trick of turning loose rings on a spindle with enlarged ends so that it is obvious the rings must have been turned in place from the one piece of wood. You can improve greatly on this stunt, however, by making some of the imprisoned rings of a different wood from the spindle. Your friends will never be able to account for this curious trick because it seems a sheer impossibility that rings of two different woods can be turned from what appears to be a single block.

Cut a piece of maple 2 by 2 by 8 in. and, using either the dado head on a circular saw or a chisel, cut a groove 2 in. from each end, both grooves being 9/16 in. deep and 1½ in. wide; do this on all



How the block is prepared and turned, and the finished novelty mounted for inspection

four sides as shown at *A*. Cut eight pieces of walnut 9/16 in. thick by 1½ in. wide by 1 7/16 in. long and glue them in the grooves with lap joints as at *B*.

After the glue has dried, center the piece in the lathe and turn the ends of the puzzle to the design shown at *C*. Then, starting at one end, turn two walnut rings, two maple rings, and finally two more walnut rings. This is done in the usual way by cutting the rings halfway through from one side and halfway from the other side and slipping the first ring along so as to give room for cutting the next. The middle part of the spindle itself also must be turned in the shape shown at *C*. The result is that there are four walnut rings loose on a solid maple stock.

Small ⅛-in. pins are driven into the ends of the turning to put in the holders, which are ½ by 2¼ by 3⅜ in., and these in turn are fastened to a maple base 1 by 4½ by 11 in., as shown at *D*. This will allow the turning to be rotated on the pins for inspection. Sandpaper the parts thoroughly and apply a clear shellac finish.—BILL F. EVERSOLE.

Balance!—in tools

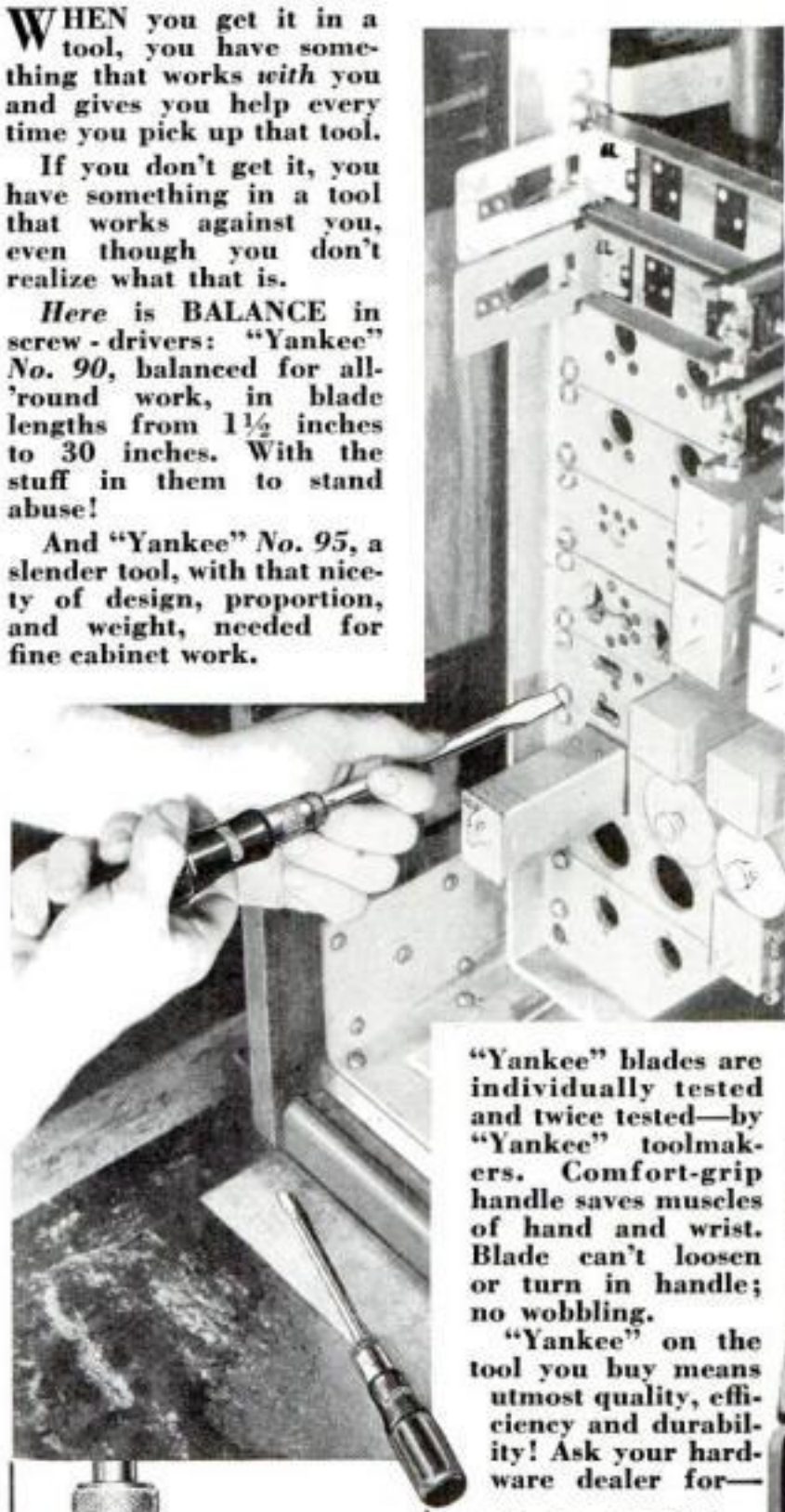
. . . Something you've heard of all your life

WHEN you get it in a tool, you have something that works *with* you and gives you help every time you pick up that tool.

If you don't get it, you have something in a tool that works against you, even though you don't realize what that is.

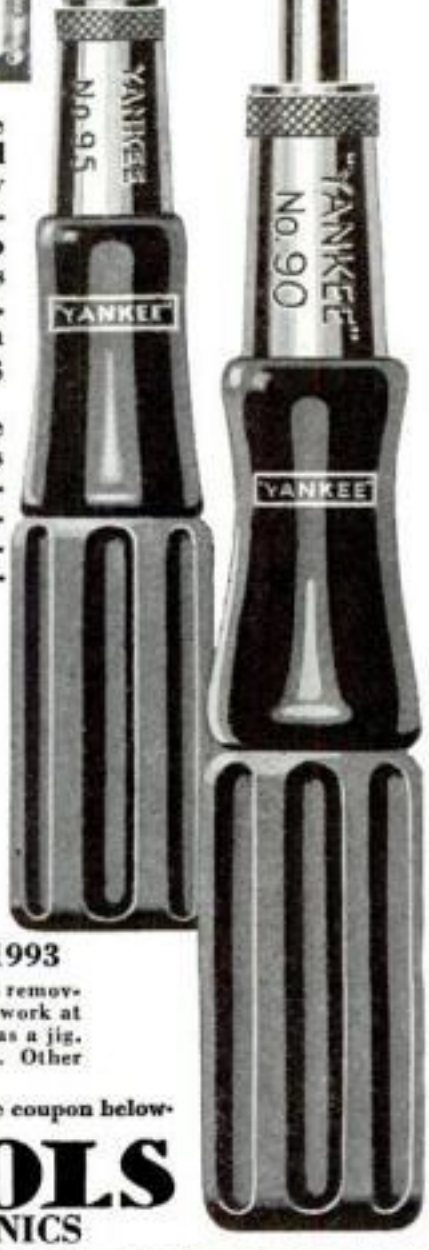
***Here* is BALANCE in screw-drivers: "Yankee" *No. 90*, balanced for all-'round work, in blade lengths from 1½ inches to 30 inches. With the stuff in them to stand abuse!**

And "Yankee" *No. 95*, a slender tool, with that nicety of design, proportion, and weight, needed for fine cabinet work.



No. 90. Standard Style: Fifteen sizes, 1½" to 30" blades. Price, for 5" blade, 50¢; 6", 55¢; 7", 65¢; 8", 75¢; 10", 95¢; 12", $1.10.

No. 95. Cabinet Style: Eleven sizes, 2½" to 15½" blades. 4½" blade, 40¢; 5½", 45¢; 6½", 50¢; 7½", 60¢; 8½", 65¢.



"Yankee" blades are individually tested and twice tested—by "Yankee" toolmakers. Comfort-grip handle saves muscles of hand and wrist. Blade can't loosen or turn in handle; no wobbling.

"Yankee" on the tool you buy means utmost quality, efficiency and durability! Ask your hardware dealer for—

"Yankee" Plain Screw-Drivers

"Yankee" Blades Can't Loosen, Turn, or Pull Out.

Bolster is immovable in handle, being held by four teeth its entire length pressed into the wood.

Blade cannot pull out. Bolster metal is punched down into nick on blade shank.

Blade cannot turn. Shank has offset wedged solidly into offset of bolster.

"Yankee" Vise No. 1993

This "Yankee" Swivel Vise is removable from base for holding work at lathe or on machine. Used as a jig. Jaws open, 3⅛". Price, $9.90. Other sizes, $3.75 up.

To get Tool Book to help you make things, use coupon below.

"YANKEE" TOOLS

MAKE BETTER MECHANICS

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

Send me "Yankee" Tool Book, illustrating quick-action tools: Two-speed (11-inch) Hand Drills, Quick-Return Spiral Screw-drivers, Adjustable-Tension Push Drills, Ratchet Breast, Hand and Chain Drills, Automatic Bench Drills, Ratchet Tap Wrenches, Removable-base Vises, Etc.

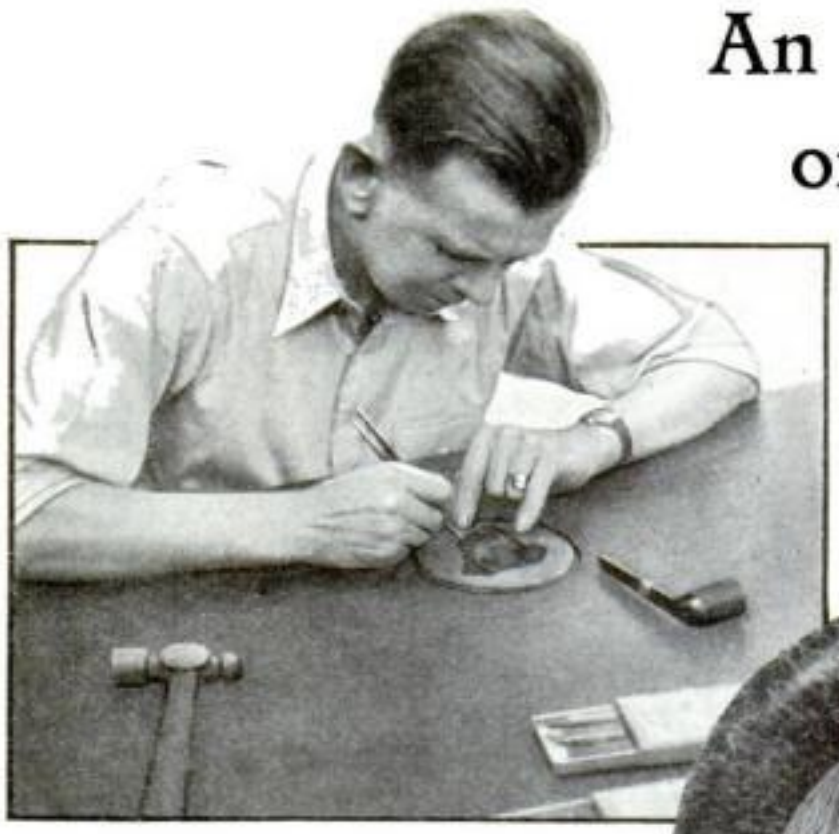
Name .....

Address .....(ps)

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 8

Copyrighted material

An Easy Way to Etch Pictures on Sheet Copper Novelties



When the paper has been removed, a sharp point is used to scratch off the asphaltum along the lines made by the pencil. *Below:* A dog's head etched by this method.

ETCHING pictures on sheet copper is a very simple process. If carried out properly, a variety of beautiful pieces may be prepared by anyone, regardless of skill. The materials needed are a few pieces of 16- or 18-gage soft sheet copper, 2 or 3 oz. of commercial nitric acid, a small can of asphaltum varnish, a camel's-hair brush, and a scratch awl.

Cut out a suitable picture from a magazine or book and lay it on a piece of the metal. Trace the outline on the copper; then paint in this area with asphaltum as shown at *A*. Let this dry for about ten hours, or until thoroughly hard. Then lay the picture over the asphaltum and with a hard pencil go over all the principal lines, pressing down slightly so that they will show. Remove the paper and go over the entire subject with the scratch awl as at *B*, scratching off the asphaltum wherever there is to be a dark line. Be sure to scratch down to the copper surface.

The etching is best done out of doors because of the fumes which are given off. Lay the metal face up on any convenient support and see that it is perfectly level. Pour enough of the commercial nitric acid over the piece so that it is completely and evenly covered, and let it remain until the acid stops working. Then plunge it into a tub of cold water. If the acid has not etched the lines deep enough, repeat the operation. The acid will eat into the copper wherever you have scratched through; it will also etch a border around the subject and make it stand away from the background. When the etching is completed, the asphaltum can be removed with kerosene, after which the piece should be scrubbed thoroughly with soap and water. To color the metal, obtain ten cents' worth of liver of sulphur from any drug store and dissolve a piece of this about the size of an olive in two quarts of cold water. Now drop the finished etching into the solution and leave it for a few seconds or until it assumes a dark brown color. Remove, wash, and let the piece dry, after which it should be burnished with jewelers' fine emery paper and brush-lacquered with a coat of banana oil or clear lacquer. The burnishing will bring out the high-lights and leave the deep cuts dark.

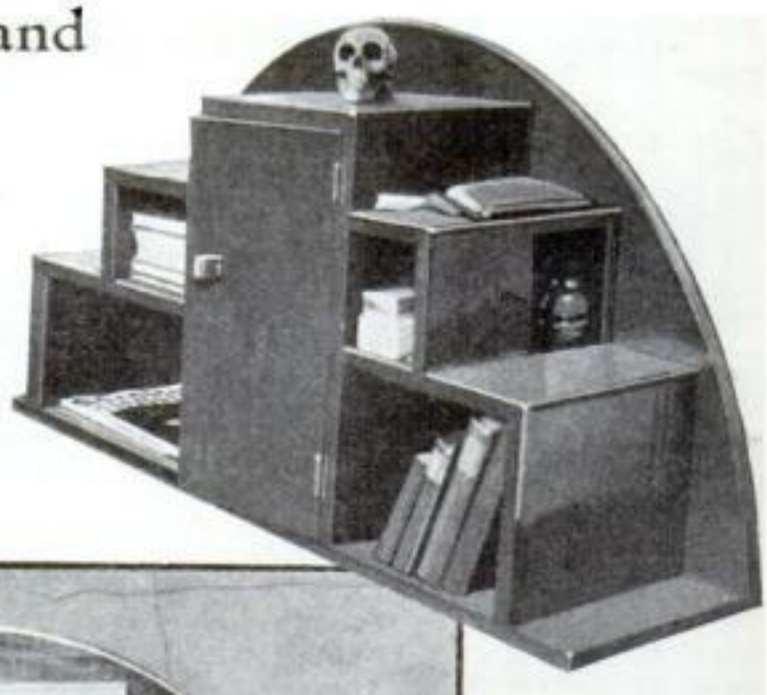
The dog's head shown here was etched into the center of a hand hammered copper pin tray.—D. H.

The two steps in preparing the surface of the copper to be etched by the nitric acid.

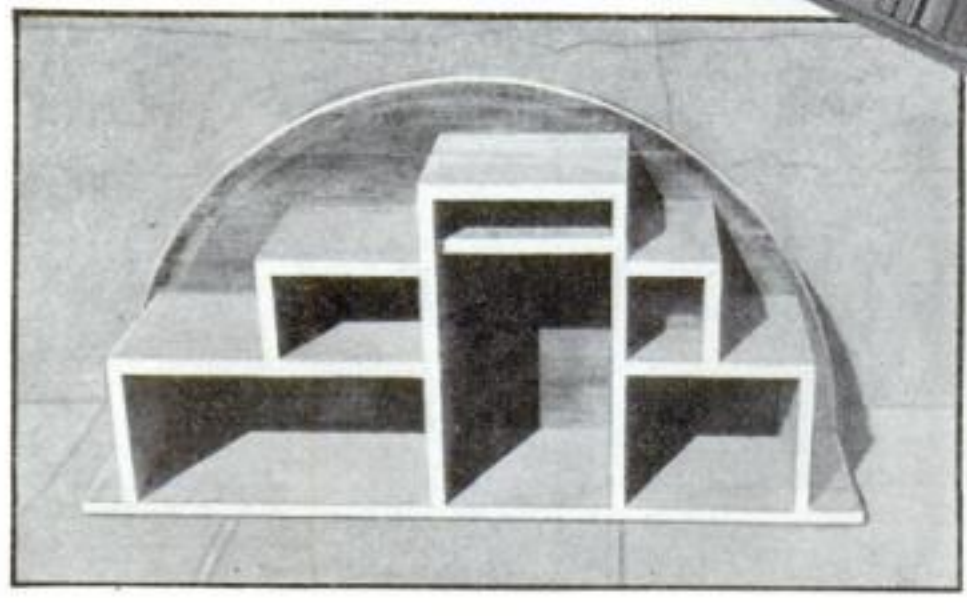
This Attractive Modernistic Bookcase and Cabinet Cost Only $1.50 to Build

IN YOUR attic or cellar there is, probably, a carload of stuff that most people would call junk, yet much of it can be converted into modern pieces of furniture and various useful, decorative things. This bookcase, for example, was made from half of the top of a discarded table and $1.50 worth of new materials—1 piece of white pine, 1 by 10 in. by 13 ft.; 2 small cans of black and 2 of pea green lacquer; 1 pair of brass hinges, 2 in. long; 1 ball and spring snap fastener for the door of the cabinet; 4 wooden balls for feet; and finishing nails, screws, composition wood putty, and sandpaper. The lacquer and small fittings were purchased in a ten-cent store.

If you have no old table from which to obtain the top, ordinary lumber or a veneered panel, of course, can be used. Having no fancy or difficult joints, the piece is extremely easy to build. Cut the lumber to the proper lengths, depending upon the size of the table top (mine happened to be 45 in. long); assemble the pieces; hang the door; sink the nails with a small set; and fill all cracks and nail holes. Then sandpaper the bookcase thoroughly; apply a coat of lacquer, and let it dry. Sandpaper again, this time lightly and with a finer grade of sandpaper, and finish with a second coat. The door knob is a 1-in. cube of wood glued and screwed in place and decorated with silver bronze.—CHARLES H. ALDER.



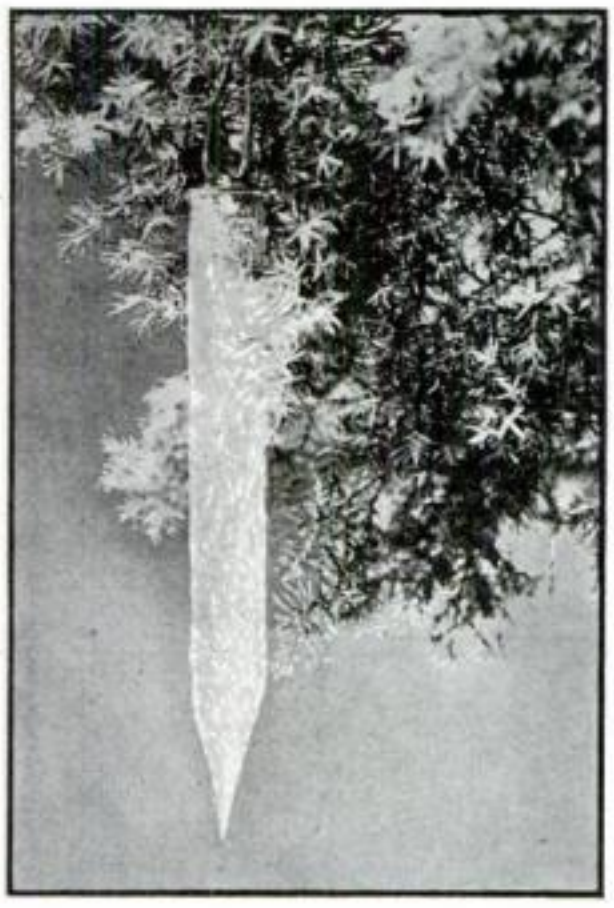
Above: To carry out the modernistic design, the cabinet is lacquered black on the outside and pea green on the inside.



At left: A view of the unfinished piece showing how half a table top serves as the back for the bookcase and cabinet.

Copyrighted material

BRILLIANT ILLUMINATED ICICLES SPARKLE ON CHRISTMAS TREE



USED with an electric Christmas tree lighting outfit, these "ice lights" resemble frosty icicles, sparkling with pin points of light from an interior radiance of many colors. Heat the closed end of a test tube in a gas flame until it is red, and by touching a piece of glass tubing to the end, draw out the tube to a point. Allow it to cool slowly to avoid breaking. Then dip each tube in clear lacquer or shellac and cover it with fine mica (artificial snow). When slipping the tubes over the tree lights, close the opening with green sealing wax.—KENNETH MURRAY.

After the test tube has been drawn out to a point, it is given a coating of mica "snow"

Read These Letters—Then TRY FOR CASH PRIZES

Here's What These Men Did With Their Samples of CASCO

Rickety Chair Made Solid And Good as New

"Had a chair, the legs and rungs of which were loosened. Today the chair is as solid as when new. I do considerable tinkering and home shop work and Casco has proven itself to be the only glue for me."—J. M. P., St. Paul, Minn.

Saved the Price of a New Clothes Wringer

"The rubber roller of our electric clothes wringer came loose, so I put some Casco on the shaft and wrapped a couple of layers of cloth tape around it. Let it stand overnight and presto, ten cents worth of Casco Glue saved the price of a new clothes wringer."—E. V., Bethlehem, Pa.

Stands Strain on Wagon Wheel Spokes

"I have used it in repairing furniture, setting spokes in wagon wheels and other woodwork. It has proven very satisfactory."—W. S. W., St. Charles, Iowa.

Exposed to Sun, Rain and Snow

"I tried it upon an auto top that was torn, and it worked alright. On wood I soaked it overnight and it was as firm as ever."—C. A. R., Lompoe, Cal.

We have received interesting letters from men who sent for samples of CASCO Waterproof Glue, telling us how they used this famous adhesive for all kinds of jobs. That leads us to think that there must be thousands of other unusual uses that we don't know about—and we're willing to pay to get this information. Write to us—tell us how you use CASCO. For the best letter received before **January 15, 1932** describing the most unusual, but thoroughly practical use of this famous glue—there will be a prize of $10.00 in cash; for the second best—$5.00—and for the third—$3.00. However, whether you win or not—

YOUR LETTER Automatically Entitles You To This "Rapid Spread" GLUE BRUSH—*FREE!*

Just write your experiences with CASCO to us—and we will send you absolutely free of charge a long life Glue Brush especially made for spreading CASCO Glue.

If You Haven't Used it Before—

Now send for this SAMPLE of CASCO WATER PROOF GLUE and WIN a CASH PRIZE!

Thousands have sent for their samples. Now get yours—use it on any job—easy or hard—and *write to us about your results.* Your letter means a free glue brush for you—and perhaps a cash prize. Mail the coupon today—and prove Casco's superiority for yourself. CASCO Waterproof Glue is the easiest, heavy-duty glue in the world to use. Just mix it with equal parts of cold water from the tap—and it's ready—ready to tackle the toughest gluing job there is. Use it on any work that has to stay glued—and you'll see that "CASCO" is another way of saying "permanent."

THE CASEIN MFG. CO. OF AMERICA, INC.
205 East 42nd St., New York, N. Y. P. S. M. 1-32

Here's my 10c (stamps) for which please send me your trial package of CASCO Waterproof Glue.

Name.....

Street.....

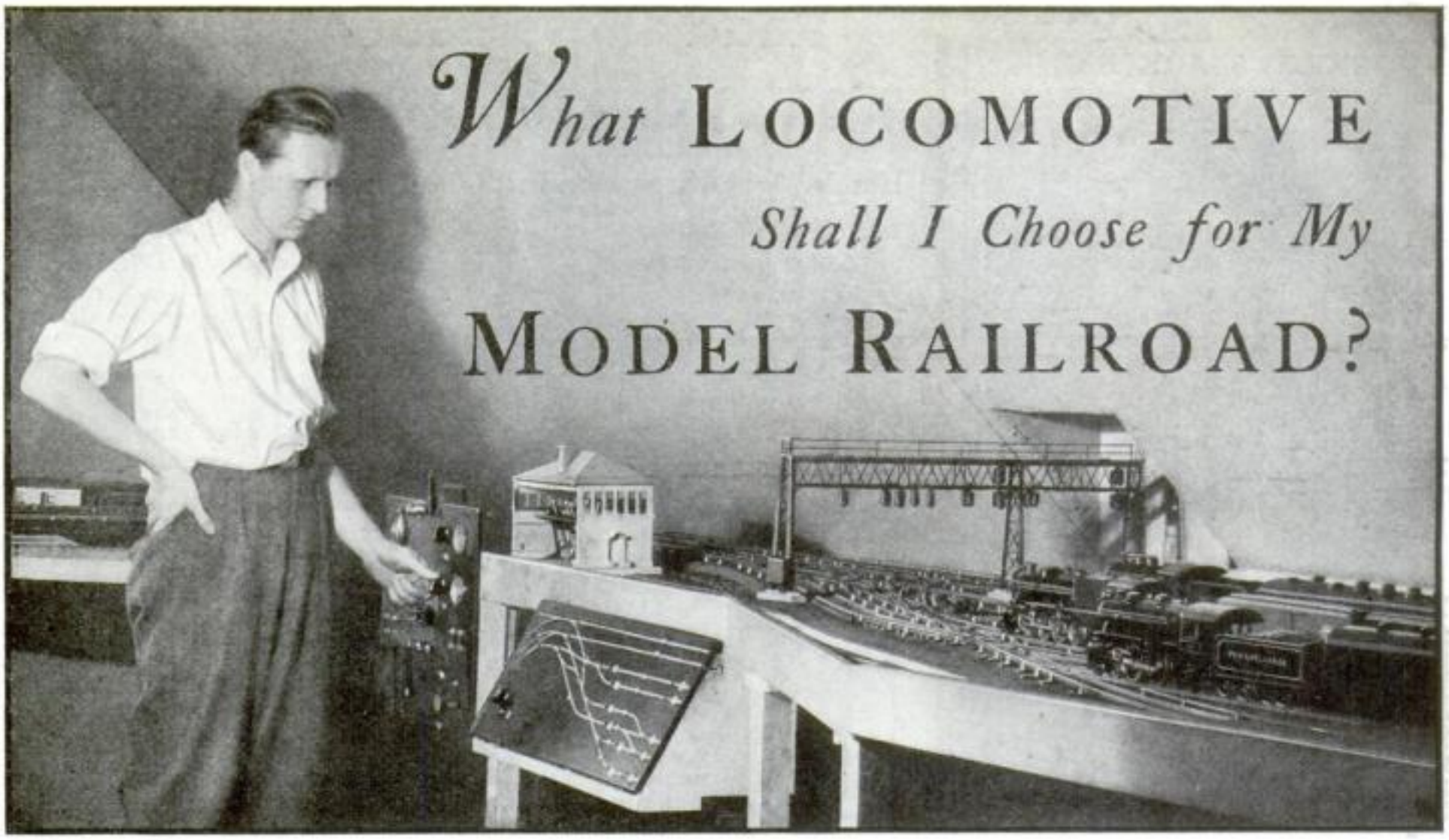
City.....*State*.....

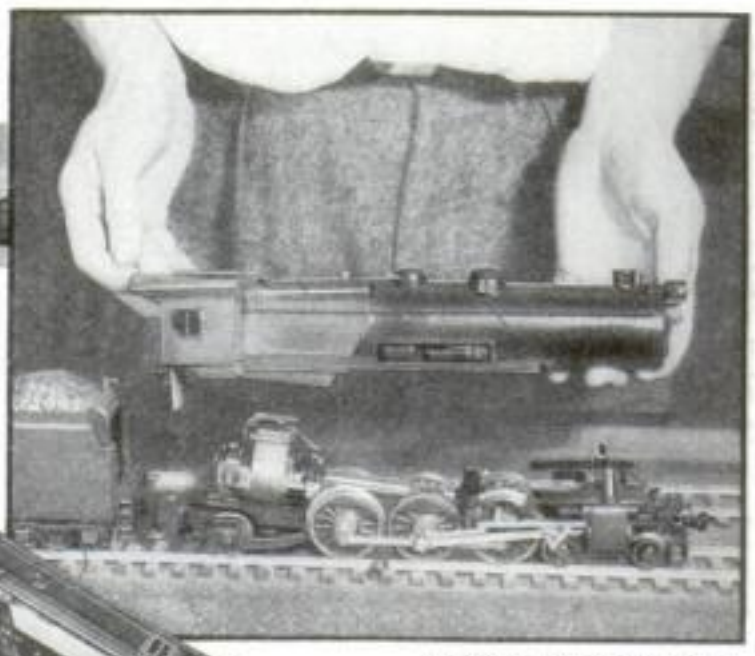
And here's my dealer's name and address (paint, hardware, or lumber dealer).....

.....

Copyrighted material

What LOCOMOTIVE *Shall I Choose for My* MODEL RAILROAD?





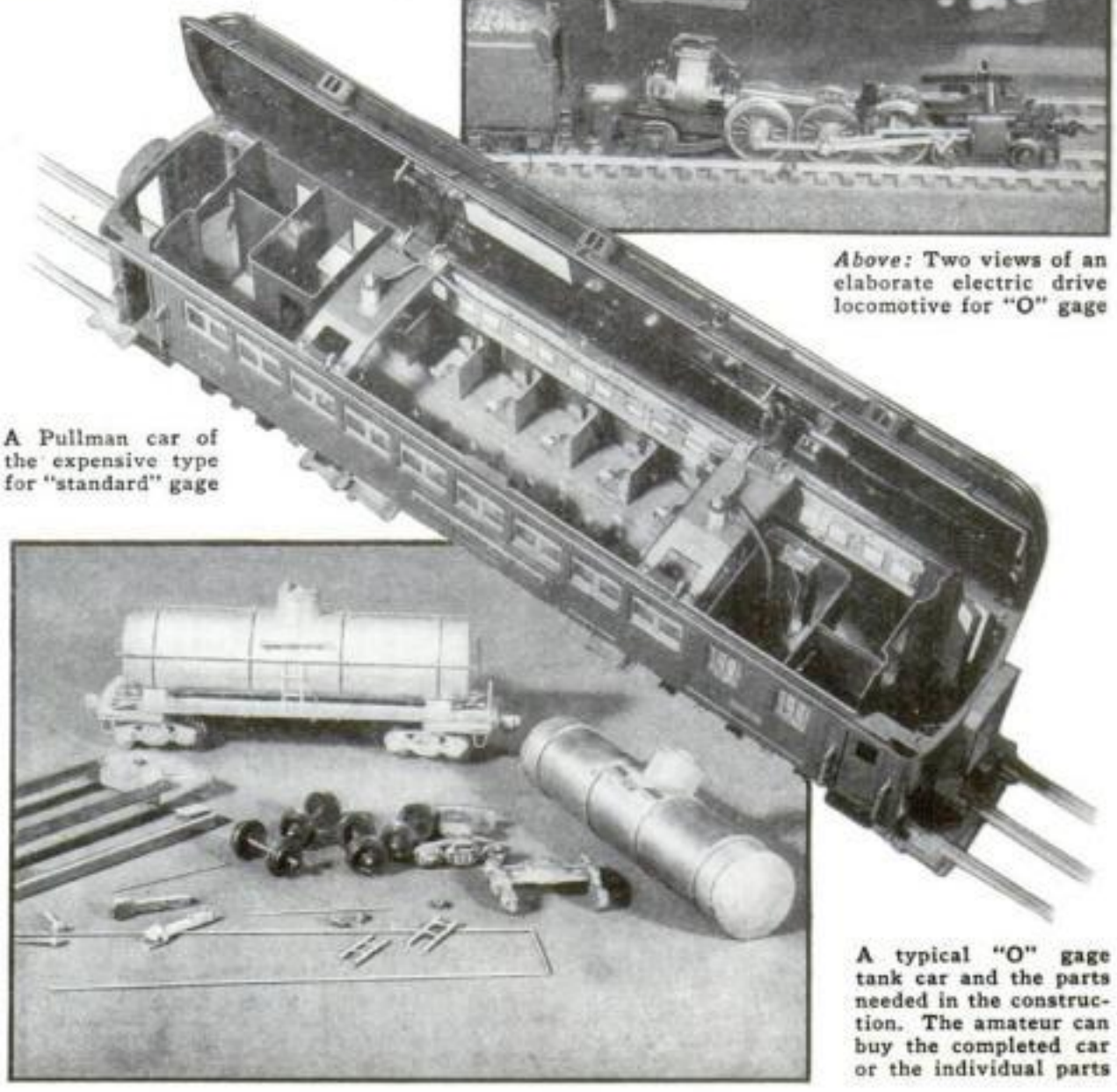
Above: Two views of an elaborate electric drive locomotive for "O" gage

By THOMAS W. ARNOLD

IF YOU are planning a model railroad system upon which trains are to be operated as on a real railroad, one of the most important questions to decide is the type of locomotive to buy or build. This must be considered as soon as you have chosen the gage and settled in a general way on the track you intend to use (P. S. M., Nov. '31, p. 106 and Dec. '31, p. 118).

On a railroad designed to be used indoors, steam may be ruled out as a possible source of power unless the entire construction, including the room in which it is housed, is absolutely fireproof. A steam-operated locomotive with its flaming alcohol or gasoline or red-hot coal is an open invitation to the fire department to come around and squirt water all over your domicile. Do not interpret this to mean that you should not build steam-operated locomotives if you wish. Indeed, about half of those model makers who have recently written to POPULAR SCIENCE MONTHLY expressed a preference for them. Provided you are mainly interested in constructing the locomotives for themselves, that is all right; but from the standpoint of actually operating an indoor model railroad system, the two practical sources of power are clockwork and electric motors.

English model railroad fans go in quite extensively for clockwork operated locomotives. They are built closely to scale, of course using *(Continued on page 109)*



A Pullman car of the expensive type for "standard" gage

A typical "O" gage tank car and the parts needed in the construction. The amateur can buy the completed car or the individual parts

Copyrighted material

EXTENSION ROLLS FOR SMALL SAW TABLE

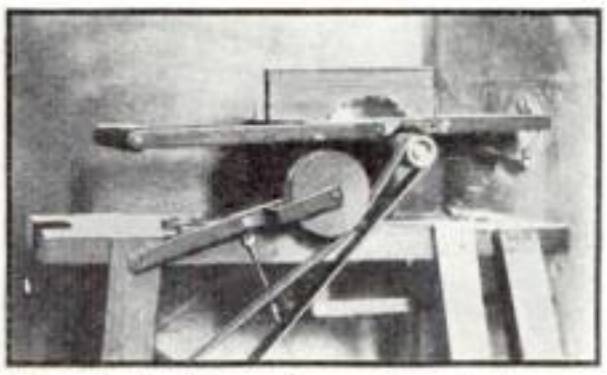


Fig. 1. A roller to bear off stock from a saw table which is hinged at the front end

FOR circular saws with small tables that are raised and lowered to regulate the cut and are hinged on the front end of the frame, an excellent roller extension can be made as illustrated in Fig. 1. It is always level with the table top no matter what position the table is in; and it does not interfere with throwing the top back to change saws.

The extra extension shown in Fig. 2 is useful when long stock is being sawed. It hooks over the arms of the permanent extension and is removed when not required. The sides of the extensions are of 3/16 by 1 in. cold rolled steel. There are four U-shaped stirrups on the extra long extension with which it is attached to the permanent extension; these were bent from ⅛ by ¾ in. flat iron by a blacksmith and are riveted to the extension arms, two on each arm, one to hook *down* and the other to hook *up*. The regular extension has a wooden roller at the end; the extra long extension has a similar roller and, a short distance from the end,

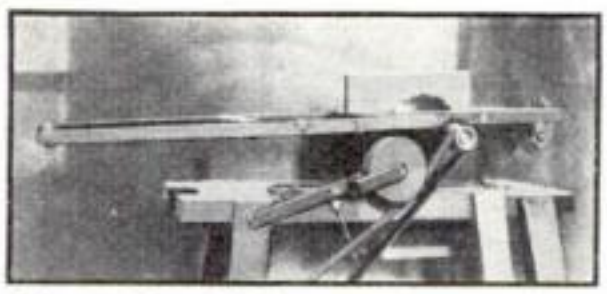


Fig. 2. For still longer work an auxiliary roller extension is hooked on the first one

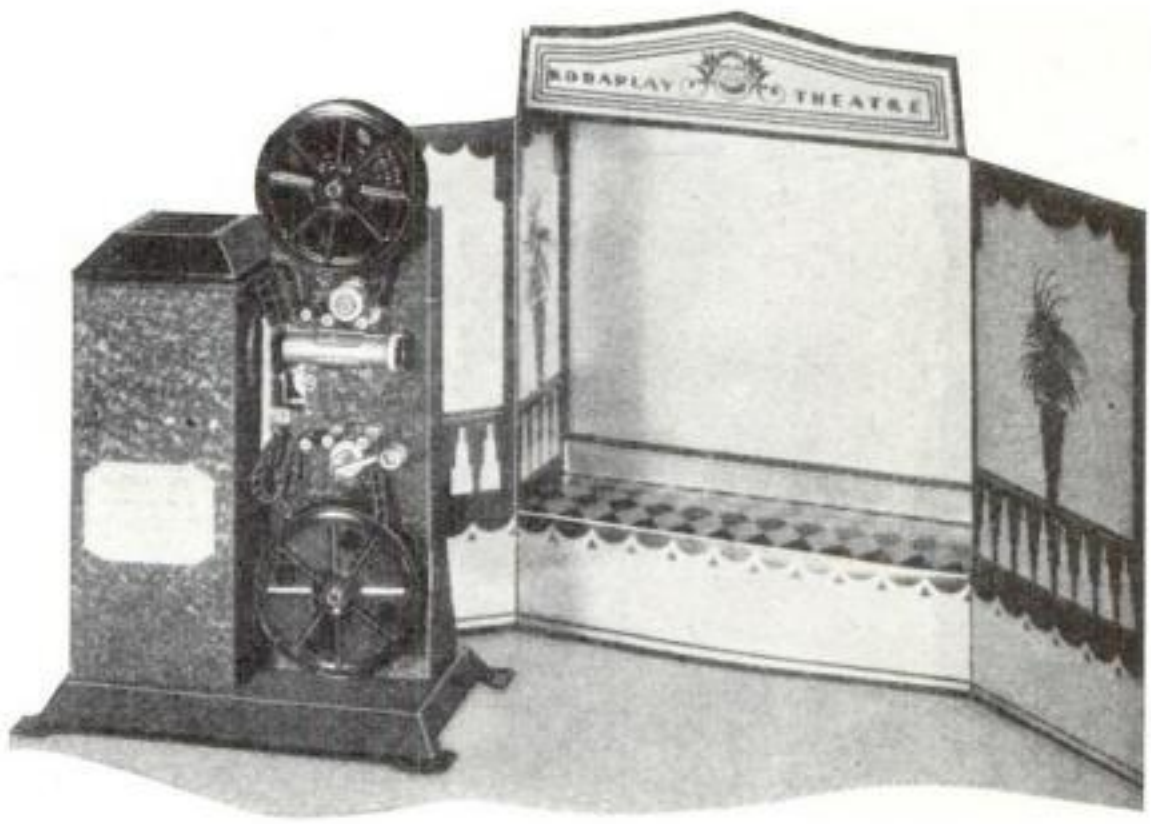
a spreader consisting of a length of pipe with a bolt through it and the arms.

Since the weight of the stock after it has passed the center would cause the table to tip up and result in a shallow cut, I drilled a ⅛-in. hole in the flange of the table a little to one side of the center and fastened the end of a 12-in. length of sash chain to the flange with a stove bolt. The other end of the chain is slipped over one of a series of four headless eightpenny nails driven at a 45-deg. angle into the end of the plank to which the saw table is fastened.—B. P. SEWARD.

BLEACHING DARK WOOD

WOOD that has darkened can be bleached by applying a thin layer of calcium hypochlorite mixed to a thin paste with water. Allow this to dry and then moisten with dilute hydrochloric acid made by mixing one part of acid to three parts of water. Brush the wood clean after a few hours. If the wood is still too dark, repeat the process.—H. B.

For Christmas



This Toy Movie Projector Eastman-made

Only $12 *Complete*

Three-blade shutter—many other features usually found only on costly machines. 400-foot extension arms available.

With Kodatoy you can show real movies at home. Charlie Chaplin . . . Felix the Cat . . . World War scenes . . . Sports . . . Adventure . . . Travel wonders. Lasts and amuses all year round!

With the extension arms now available, you can run 400 feet of film at one showing without stopping to change reels and re-thread. Kodaplays—special short-length movie subjects—cost only 30, 60 or 90 cents each.

Kodatoy projects exceptionally clear, brilliant, flickerless movies on its own "silvered" screen. Powerful condensing and projection lenses—dependable claw pull-down—sprocket threading—automatic framing—three-blade shutter—all combine to make Kodatoy an outstanding value at its low price.

Easy to operate and safe because it uses 16 mm. (the home movie size) *Safety Film* only.

Complete Kodatoy outfit costs only $12—hand operated. With motor, $18.50. Outfit includes projector, miniature theatre with "silvered" screen, and two empty 100-foot metal reels. Universal models for D. C. or A. C. (any cycle) available at only slightly higher prices. See it at Kodak dealers', toy and department stores. EASTMAN KODAK CO., Rochester, N. Y.

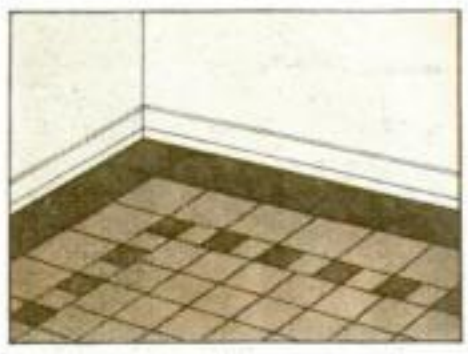
KODATOY

Copyrighted material

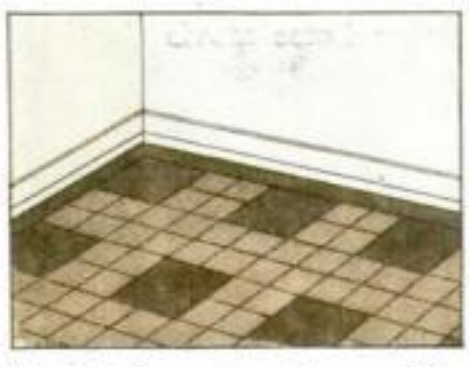
New in method style and mode

MASONITE Cushioned FLOORING

OF TEMPERED PRESDWOOD



This illustration shows an interesting three-border effect, with smaller squares alternating in light and dark shades.



In this illustration, the reversible shades produce a pleasing effect with smaller squares. Wax or polish Masonite Cushioned Flooring, if you wish. Takes it beautifully.

First in this remarkable Masonite family came Structural Insulation and QuartRboard, next Presdwood, then Tempered Presdwood . . . and now *Masonite Cushioned Flooring* —both a flooring and a floor covering, and new and modern in method, style and mode.

As its name suggests, it has an in-built shock absorber, which eliminates much of the fatigue and discomfort from walking. It is of three-ply construction—outer layers of *durable, wear-resisting* Tempered Presdwood, impervious to moisture and specially toughened by a process similar to that used in tempering steel; an inner layer, or cushion of QuartRboard to provide resiliency, insulation, sound absorption.

Masonite Cushioned Flooring is *beautiful*, with endless combinations of design and pattern. It is *economical*, in first cost, in application, in long life, in elimination of floor covering.

Architects, contractors, home and building owners appreciate its practical features, its utility either in new construction or modernizing. Note its distinctive points listed on opposite page. Also send coupon—today—for folder.

CROSS-SECTION OF MASONITE CUSHIONED FLOORING . . . OUTER LAYERS OF TEMPERED PRESDWOOD . . . INNER LAYER OF QUARTRBOARD . . . NOTE REVERSIBLE COLORS AND INTERLOCKING JOINTS

Copyrighted material

Note the tongue-and-groove construction of the squares. Tight-fitting joints, a perfectly smooth floor.

Ten points of superiority

Masonite Cushioned Flooring—the new, all-wood flooring with the in-built shock absorber—offers these advantages:

1. **Appearance**—Beautiful, indeed, these smooth, grainless squares with an endless variety of design.
2. **Durability**—Built to withstand wear and tear; Tempered Presdwood surfaces are an assurance of long service.
3. **Style**—Something entirely new in flooring; modern floors that will appeal to everyone.
4. **Resiliency**—A cushion of shock-absorbing QuartRboard in-built to make walking easy and restful.
5. **Grainless** — An all-wood flooring; yet completely free from splinters; will never split or crack.
6. **Perfect Joints Interlocked** —Tongue-and-groove construction, with special tapering of edges, provides a smooth, snug fit.
7. **Easily Laid**—Can be either nailed or cemented.
8. **Variety of Designs** — No end to possible patterns. Squares 6, 9, 12 inches square; borders 3, 6, 12 inches wide, 47 inches long.
9. **Reversible Squares**—Dark on one side, light on the other. Two shades always available.
10. **Both a flooring and a floor covering** — All combined into a single unit.

Masonite
Cushioned **FLOORING**

STRUCTURAL INSULATION · INSULATING LATH
PRESDWOOD · QUARTRBOARD

© M. C. 1931

Clip out the coupon below. Send it in today, with your name and address. You'll find much to interest you in the free Masonite Cushioned Flooring folder it brings.

MASONITE CORPORATION, Dept. D 111
111 W. Washington Street, Chicago, Ill.

Please send your free illustrated folder that describes Masonite Cushioned Flooring.

Name _____

Street _____

City _____ *State* _____

CROSS-SECTION OF MASONITE CUSHIONED FLOORING . . . OUTER LAYERS OF TEMPERED PRESDWOOD . . . INNER LAYER OF QUARTRBOARD

Copyrighted material

OVER 400
types and sizes of Brown & Sharpe Micrometer Calipers

There is a Brown & Sharpe Micrometer for every requirement of mechanics, toolmakers, automotive service men, and home workshop enthusiasts. Here are five typical styles

No. 8
Range 0 to 1"
by thousandths of an inch
The "standard" micrometer with skilled mechanics.

No. 12
Range 0 to 1"
by thousandths of an inch
Narrow frame at anvil permits its use in places where frame of usual style will not enter.

No. 24
Range 0 to 1"
by *ten-thousandths* of an inch
Measures to *ten-thousandths* in a new easy way. Ten-thousandths can be read direct from auxiliary thimble.

No. 38
Range 1" to 2"
by thousandths of an inch
A reliable micrometer for measuring from 1 inch to 2 inches.

No. 54
Range 0 to 4"
by thousandths of an inch
Because of its range, this micrometer is especially suited for automotive service work. Other styles to 24 inches.

Complete description of these micrometer calipers, together with over 2300 other Brown & Sharpe Tools, is included in our Small Tool Catalog No. 31. Ask your dealer for a copy or write to us for one. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

Brown & Sharpe Tools

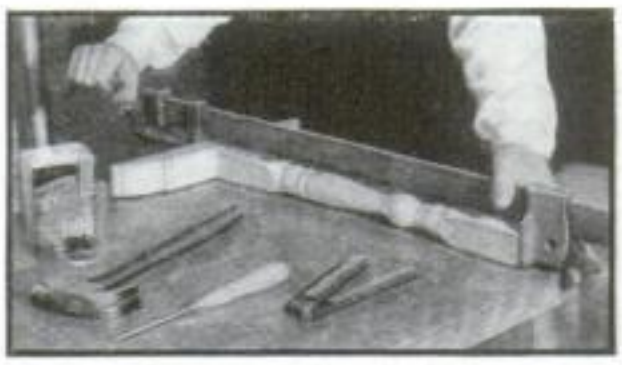
"World's Standard of Accuracy"

POPULAR SCIENCE HOMECRAFT GUILD

(Cont'nued from page 77)

Then carefully spread the loose assembly to allow glue to be applied to the dowels and dowel holes between *B* and *E*. Glue and clamp these joints. Then drive the wedges through the small ends holes in stretcher *F* so as to draw each leg post *B* tightly against the shoulder of *F*. No glue is necessary in these stretcher joints, but the wedges may be fastened securely, if desired, by driving a finishing nail into each from the under edge of the stretcher. Test to see that the assembly is square and without twist. Then do not disturb until the glue is dry.

3. Lay the toppieces face down, see that the oval outline is perfect, and attach the hinges with the screws provided, setting them at least 1 in. from the end.



In assembling the table, the first step is to glue each of the feet to one of the legs

4. Fasten the top *A* to the top rail *E* with four screws, and use glue also, if you wish. Make two small wooden stop blocks as shown in one of the drawings and glue them under the leaves of the top as stops against which the butterflies will strike when opened at right angles to the top rail.

5. Remove any surplus glue and round any corners missed in previous operations. Inspect for blemishes and smooth with No. 00 sandpaper where necessary.

The finishing should be done in the following steps:

1. Apply the combined stain and filler freely with any clean brush and distribute it evenly with a pad about the size of the palm of your hand and folded until about ¼ in. thick. The brush is used merely to apply enough material to be distributed by the pad and as an aid in reaching into all crevices and corners. Allow no delay between the application by the brush and the distribution. For this reason all processes of staining and finishing should be done in sections, first one part, then another. The depth of the staining can be controlled by the pad; increased rubbing will lighten the color. Very slight irregularity in the stain color is desirable, and the edges of the top, as well as the greater projections of the curves on the other parts, should be rubbed lighter than the body. Allow the stained piece to dry at least 30 minutes.

2. Apply the protector coat from can two with a brush and distribute it evenly with another pad. Take special care with the turned legs, wiping the finishing material around with deft strokes until thinly and smoothly coated. When the piece is thinly and smoothly coated, allow it to dry for 24 hours.

3. Use the gloss coat from the third can in exactly the same way. Do the padding with little pressure. By doing more padding it is possible to emphasize the parts which were rubbed lighter in the staining process. By repeating the padding on these edges and curves after the first application has set, an extra luster can be given. In doing this a brush need not be used, as the shellac can be applied to the pad so that it is well moistened. A still higher gloss may be obtained by repeating the shellac coating. This completes the finish, although it may be further improved by rubbing it very cautiously and gently, when thoroughly dry, with a new pad moistened with any light, thin oil such as sewing machine oil and sprinkled with a little FF powdered pumice stone or rottenstone, both of which may be obtained at paint stores. You will find this finish full of life and brilliance and altogether different from the uniform and monotonous finish applied by spraying to ordinary commercial furniture. The ideal finish should always be thin and transparent so that there is no evidence of a body of finishing material between the eye and the wood. Something of the quality of the finish can be observed in the photographs on pages 76 and 77. This table was finished by the method described in three operations and left without being rubbed with pumice stone as an example of the remarkably fine results which can be obtained in this simple way.

The coupon below is for your convenience in ordering the construction kits for the butterfly table. The kit is sold with an absolute money-back guarantee; if you are dissatisfied in any way after receiving it and have not marked or damaged it in any way, you may return it and your money will be refunded without question.

If you have suggestions for other pieces you would like to have the Guild design and prepare in kit form, send them in at once. The Guild has been established for your service, and the scope of its activities will be determined wholly by your interest. As the number of butterfly table kits is limited, send for yours today.

Popular Science Homecraft Guild
381 Fourth Avenue
New York, N. Y.

Please send me your complete construction kit for making a Colonial butterfly table, including all wooden parts, hardware, and finishing materials. I inclose $6.90. It is understood that this includes the shipping charges and that if the kit should prove unsatisfactory I can return it within ten days, and the amount paid will be refunded at once.

Name .....

Address.....

City .....

State.....

Note: This offer is made only to readers living in the United States. Prices in Canada and elsewhere are higher; write for them if interested.

Copyrighted material

BLUEPRINTS FOR MODEL OF WORLD'S FASTEST FISHING SCHOONER

Mounted, the model of the *Bluenose* is as graceful and trim as its larger prototype

THE *BLUENOSE*, Canadian fishing schooner, by winning two decisive victories over the American challenger *Gertrude L. Thebaud*, again holds the North Atlantic fisherman's trophy first gained by her ten years ago. Sailing gracefully in the recent international races, she earned herself the reputation of being the fastest schooner in the Great Banks fleets and was able to follow the quaint old custom of lashing a new broom to the tip of her fore-topmast as emblem of victory.

Few boats offer the model maker a more decorative subject than the *Bluenose* (see P.S.M., Nov. '29, p. 79). Aloft and alow she is as graceful as any fore-and-after, and the comparative simplicity of her rigging is an advantage from the standpoint of the beginner. The construction of a 20-in. model of this international champion is shown in detail on POPULAR SCIENCE MONTHLY Blueprints Nos. 110, 111, and 112 (see page 110). These blueprints also contain drawings showing how the model maker can mount the schooner on an imitation sea as shown above.

HOW TO PUNCH HOLES IN SPRING STEEL STOCK

FINDING it necessary recently to punch holes in several pieces of phonograph spring stock, I drilled a hole a trifle larger than the size of the punch to be used into a piece of soft steel, mounted the punch in the chuck of a drill press, clamped the soft steel die to the drill press table, and placed the clock spring steel in position over the hole. Then I held the point of a small gas flame directly on the spot where the hole was to be punched; and as soon as the steel began to redden and without removing the flame, I quickly dropped the punch and raised it with equal speed. In this way the holes were formed with a minimum of effort and without taking the temper out of the spring.—FERD. H. LEONHARDT.

"Lastly," *said Stevenson*, giving his rules for a happy marriage,

"NO WOMAN should marry a man *who does not* SMOKE"

AND the words which follow indicate that by *smoking* Stevenson meant *smoking a pipe.*

"Whatever keeps a man in the front garden," he says, "whatever checks wandering fancy and all inordinate ambition, whatever makes for lounging and contentment, makes just so surely for domestic happiness."

Not *all* smoking makes for "lounging and contentment."

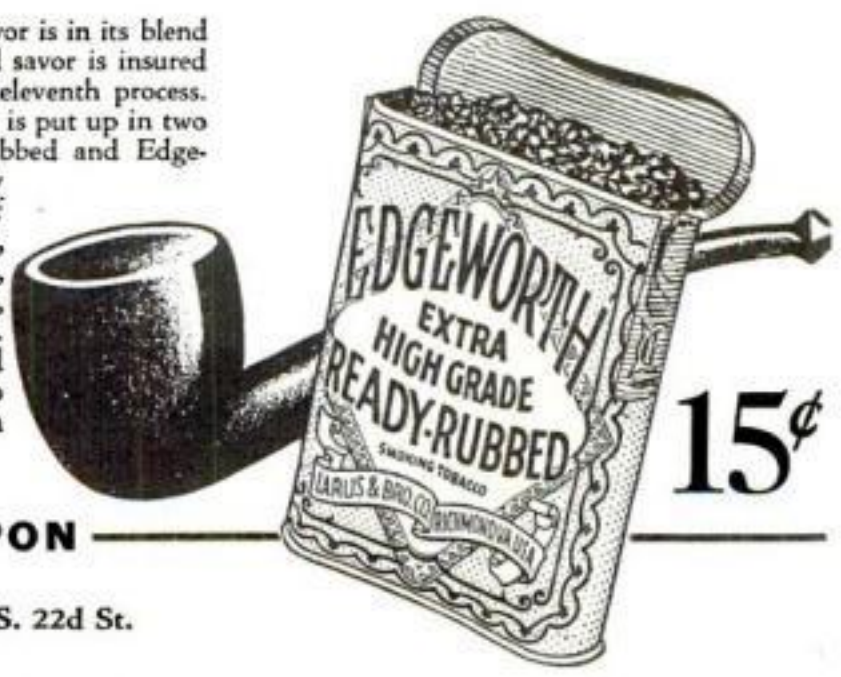
There is the quick, nervous smoke which is the characteristic reaction of our too speedy modern life. It has its place, but it is a *part* of our nervous strain, not an *antidote* to it.

The pipe is long and slow and placid. The pipe soothes and relaxes and charms. The pipe sends out those cloud-like wreaths in which the eyes of affection picture the faces of loved ones and the visions of peace.

Pipe smokers relax, and enjoy and live longer. Find the pipe that fits your taste and smoke a pipe.

You can buy Edgeworth wherever good tobacco is sold. Or, if you prefer, you can use the coupon below to get a special sample packet of Edgeworth, free. Address Larus & Bro. Co., 100 S. 22d Street, Richmond, Va.

The secret of Edgeworth's flavor is in its blend of fine old burleys. Its natural savor is insured by a distinctive and exclusive eleventh process. For the pleasure of smokers it is put up in two forms: Edgeworth Ready Rubbed and Edgeworth Plug Slice. Sold by dealers nearly everywhere. If your dealer will not supply you, send your order to the makers, Larus & Bro. Co., Richmond, Virginia. Pocket Size Tin, 15¢. Half-pound Tin, 75¢. Pound Humidor Tin, $1.50. Also packed in Vacuum Tins in pound and half-pound sizes.



15¢

CLIP COUPON

LARUS & BRO. CO., 100 S. 22d St.
Richmond, Va.

Send me the Edgeworth sample packet. I'll try the Edgeworth in a *good* pipe.

Name_____

Address_____

City and State_____ K-85

LISTEN TO THE DIXIE SPIRITUAL SINGERS AS THEY SING IN THE EDGEWORTH FACTORY, N. B. C. BLUE NETWORK EVERY THURSDAY EVENING

Copyrighted material

"I'll see it through if you will!"

"THEY tell me there's five or six million of us—out of jobs.

"I know that's not your fault, any more than it is mine.

"But that doesn't change the fact that some of us right now are in a pretty tough spot—with families to worry about—and a workless winter ahead.

"Understand, we're not begging. We'd rather have a job than anything else you can give us.

"We're not scared, either. If you think the good old U. S. A. is in a bad way more than temporarily, just try to figure out some other place you'd rather be.

"But, until times do loosen up, we've got to have a little help.

"So I'm asking *you* to give us a lift, just as I would give one to you if I stood in your shoes and you in mine.

"Now don't send me any money—that isn't the idea. Don't even send any to the Committee which signs this appeal.

"The best way to help us is to give as generously as you can to your local welfare and charity organizations, your community chest or your emergency relief committee if you have one.

"That's my story, the rest is up to you.

"I'll see it through—if *you* will!"

—Unemployed, 1931

THE PRESIDENT'S ORGANIZATION ON UNEMPLOYMENT RELIEF

Walter S. Gifford
Director

COMMITTEE ON MOBILIZATION OF RELIEF RESOURCES

Owen D. Young
Chairman

The President's Organization on Unemployment Relief is non-political and non-sectarian. Its purpose is to aid local welfare and relief agencies everywhere to provide for local needs. All facilities for the nation-wide program, including this advertisement, have been furnished to the Committee without cost.

"HOME WORKSHOP MANUAL"

at a new low price!

16 COMPLETE SECTIONS

It is hard to believe that such a great variety of things to make can be covered in such complete detail until you actually see the book and look through its sixteen big sections.

1. Building Fine Furniture by Hand.
2. Furniture of Modern Design.
3. How to Use Small Woodworking Machinery.
4. Repairing Old Furniture.
5. Toys to Delight the Children.
6. Novelties—Ornamental and Amusing.
7. Woodturning Simplified.
8. Decorative Metal Work.
9. Model Making.
10. Radio and Electrical Projects.
11. Improvements for House and Garden.
12. Boats and Sports.
13. Painting and Decorating.
14. Woodworking Tools.
15. Equipment to Make for Your Home Shop.
16. Better Home Workshop Methods.

Order NOW—send NO MONEY—and get this BIG WORKSHOP MANUAL for $1.05 less than the regular price.

REGULAR PRICE $5.00—NOW ONLY $3.95

With Your Name In Gold On The Front Cover

SEND NO MONEY—Just This Coupon

ORDER ON THIS COUPON

Popular Science Publishing Co.,
381 Fourth Avenue, New York, N. Y. (PS. 1-32)

Please send me a copy of the regular $5 edition of The Home Workshop Manual for only $3.95 C. O. D. plus a few cents postage, in accordance with your offer. Print my name in gold on the front cover. If I am dissatisfied with the book I may return it and you will refund my money. (Please print your name below so that it will be properly spelled on your book).

Name .....

Address .....

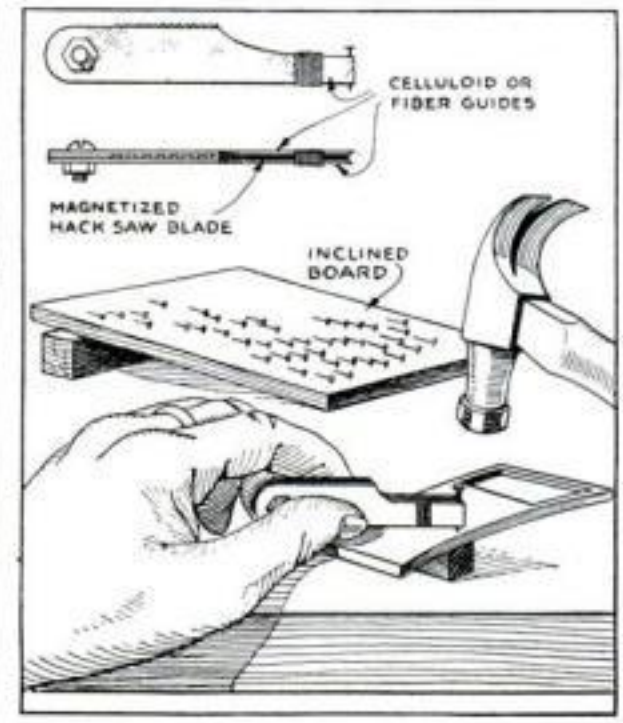
City ..... State .....

Orders from outside United States and possessions must be accompanied by payment in advance

STARTING SMALL NAILS IN DELICATE PARTS

BECAUSE they are so small, the brads and nails used in model making are difficult to hold, and unless they are started into the piece just right they will often cause splitting.

A simple little tool for holding them that will do much to avoid this trouble may be made in a moment's time from a broken hack saw blade. The cutting edge is ground down so that the width of the blade is slightly less than the nail's length, and the end is made square with the back of the blade. Then it is magnetized. Two pieces of fiber or celluloid are next cut out the same shape as the blade but long



Small nails used in model work can be easily handled with this simple magnetic holder

enough so that their ends protrude slightly beyond the squared end. One is fastened on each side of the blade as shown in the drawing above.

The magnetized bit of hack saw holds the nail to its edge, and the fiber sides keep it erect. A slight tap then starts the nail so that the guide tool may be removed and the nail driven in.

If the nails are sprinkled on a slightly inclined board and the board given a tap or two, they will all swing until they point in one direction. So arranged, they may be picked up easily with the magnetized holder.—NORMAN V. DAVIDSON.

INEXPENSIVE SEALS FOR CHRISTMAS PACKAGES

A TYPE of Christmas seal that is strong and at the same time appropriate for the season can be made with a household cement of the liquid celluloid variety. Drop a small pool of the liquid on the package and immediately dust it over with artificial snow (powdered mica). When it is dry, which will be within a few minutes, it will sparkle as if coated with diamond dust. Another use for household cement is in sealing ordinary letter correspondence where absolute privacy is desired. Stick down the flap with cement and no amount of steaming will open the letter, and it cannot be opened with a sharp penknife or razor without tearing the flap of the envelope.—K. M.

Jan 1932

Copyrighted material

NOW—A Powerful New 11-Tube Super Heterodyne at a Sensationally Low Price!

Save up to 50%

Easy Terms

Pay as you Play Your Mid-west! Terms as low as

$5.00 Down

only $37.50

COMPLETELY ASSEMBLED

With Specially Matched Large DYNAMIC SPEAKER

30 DAYS FREE TRIAL

Push-Pull Pentode Power Output Tubes—Multi-Mu Screen Grid Tubes—Real Automatic Volume Control—All the Latest Improvements That Give Amazing New Clarity, Perfect Tone, Split-Hair Selectivity and Sensitivity Never Before Heard Of!

RADIO FANS! Just what you've been looking for! A powerful, new 11-tube radio at an unbelievable low price. And what a radio! *Two Push-pull pentode* power output tubes with twice the power and four times the sensitivity of ordinary 45's—and three Multi-Mu tubes, together with a –24 first detector, gives you SIX SCREEN GRIDS. These six screen grids, together with the –27 oscillator, second detector first A.F., and automatic volume control—the –80 tubes—gives a total of ELEVEN TUBES, with reception equal to fifteen ordinary tubes—in a perfectly balanced, non-oscillating, non-radiating, super-heterodyne *TEN-TUNED* circuit with *real Automatic Volume Control* that holds those powerful locals down to the same volume as the distant stations and counteracts that annoying fading on weak stations.

The use of a band-pass or pre-selector stage, together with Multi-Mu tubes, makes this radio actually surpass 10 K.C. selectivity. Absolutely eliminates those noisy singing "birdies" and annoying cross talks. You'll be positively amazed and delighted when you see this sensational new set, hear the beautiful mellow, cathedral tone—know what it means to have that pin-dot selectivity and unequaled sensitivity.

Be convinced—TRY IT 30 DAYS BEFORE YOU BUY. Don't send a penny. Mail coupon right now for amazing FREE trial offer and complete details. You'll be surprised.

TERMS *as low as* $5.00 DOWN

Complete Line of **Consoles**

Rush the coupon for big, beautiful catalog that illustrates the complete line of MID-WEST console cabinets. All new, all different, all priced to save you 30% to 50%. You'll gasp with admiration when you see the vast selection of beauty, style and grace that is crafted into every MID-WEST Console. The catalog is FREE—it doesn't cost you a penny! Rush the coupon—NOW!

Deal Direct with Big Mid-West Factory

—Save Middlemen's Profits

Never before in the history of radio has such a powerful set been offered at Mid-West's amazing low price. Deal direct with the big MID-WEST factory. Save the jobber's profit. Your outfit will reach you splendidly packed, rigidly tested with everything in place ready to plug in. No assembling! Entertain yourself for 30 days absolutely FREE—then decide. You are not obligated to buy. Save up to 50 per cent in buying direct from factory—insure satisfaction—deal direct with the world's veteran radio builders—MID-WEST. And don't forget—every MID-WEST outfit is backed by an absolute guarantee of satisfaction. You take no risk.

Big Pay for USER AGENTS

If you are interested in making BIG MONEY in spare time for just showing your MID-WEST Radio to friends and neighbors, then check the coupon and mail it immediately for complete details. Special guarantee and FREE trial offer eliminates all risk. Your big opportunity—Hurry!

RUSH THIS COUPON FOR AMAZING FREE TRIAL OFFER AND BIG BEAUTIFUL CATALOG

Mid-West Radio Corp.
Dept. 36, Cincinnati, Ohio

☐ Enclose Special "User Agent" proposition.

Gentlemen: Please rush my copy of your big, beautiful new catalog and complete details about the powerful, new 11-tube super-heterodyne outfit. This is not an order, and I am not obligated.

Name .....

Address .....

Town .....

State .....

MID-WEST RADIO CORP. EST. 1919

DEPT. 36 CINCINNATI OHIO

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 8

Copyrighted material

EASY TO BLOW. Easy to finger. Easy to play in perfect tune. Learn quicker and win greater musical success. Sousa and the world's greatest artists endorse Conns. They have proved Conn superiority. The secret is in Conn's patented construction. Many exclusive features. Yet they cost no more.

FREE TRIAL, EASY PAYMENTS. Any Conn Band or Orchestra instrument sent on free trial. Liberal Easy Payment Plan. Write for special offer.

Send For FREE BOOK. Describes your favorite instrument. Gives history, place in band, points out money making opportunities. Illustrates newest models in natural colors. Mention instrument.

C. G. CONN, LTD.
132 Conn Bldg., Elkhart, Indiana

CONN
World's Largest Manufacturers of
BAND INSTRUMENTS

Write for FREE BOOK
Mention Instrument

Be a Boy Chemist - get

REGISTERED TRADE MARK
CHEMCRAFT
THE CHEMICAL OUTFIT

Perform hundreds of fascinating and useful experiments just like a real chemist. You can do magic chemical tricks, too. CHEMCRAFT is the best chemistry set; more experiments, superior chemicals and better apparatus. Get CHEMCRAFT; select from these sets:

No. 1—$1.00 No. 3½—$3.50 No. 8—$ 8.00
No. 2—$2.00 No. 5 —$5.00 No. 10—$10.00
No. 15—$15.00 No. 25—$25.00

(Nos. 5, 10, 15 and 25 come in handsome wood cabinets). No. 8 (Portable) is packed in a convenient carrying case.

Ask for CHEMCRAFT by name; look for the name CHEMCRAFT on the box; then you will have the best outfit.

Try Chemistry for 25c!
Get CHEMCRAFT Junior and do lots of interesting experiments and tricks. Complete outfit and instructions postpaid for 25c. Send for yours now!

Free Chemical Surprise!
Send us the name and address of the store where you live that sells toys, and we will send you a wonderful Chemical Surprise absolutely free.

THE PORTER CHEMICAL CO.
501 Washington Street Hagerstown, Maryland

free RADIO CATALOG

New 10th Anniversary Catalog just out! 144 pages crammed full of bargains. Everything new in radio at lowest wholesale prices. Replacement parts, tubes, kits, speakers, accessories, Lafayette 7, 8 and 10 tube Super-Heterodynes, etc. Brand new, nationally advertised radio merchandise. Write for this FREE 144 page book today.

WHOLESALE RADIO SERVICE CO.
Dept. A-27
38 Vesey St., New York, N. Y.

New 1932 bargains

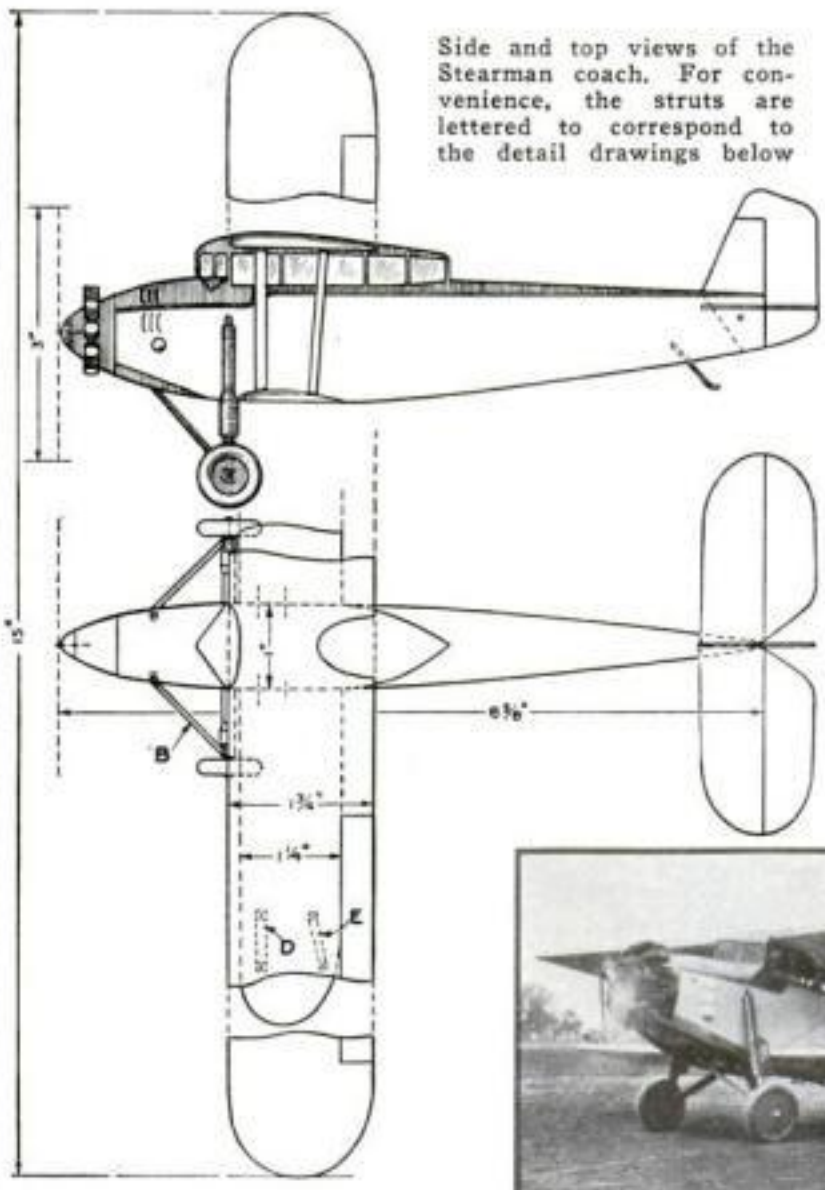
Modeling a Cabin Biplane

ALTHOUGH this model of the Stearman coach biplane differs somewhat from the other cabin models previously described in this series (see P.S.M., Nov. '31, p. 112, for complete list), it is just as easy to build and when finished and painted will form a neat addition to your scale model collection.

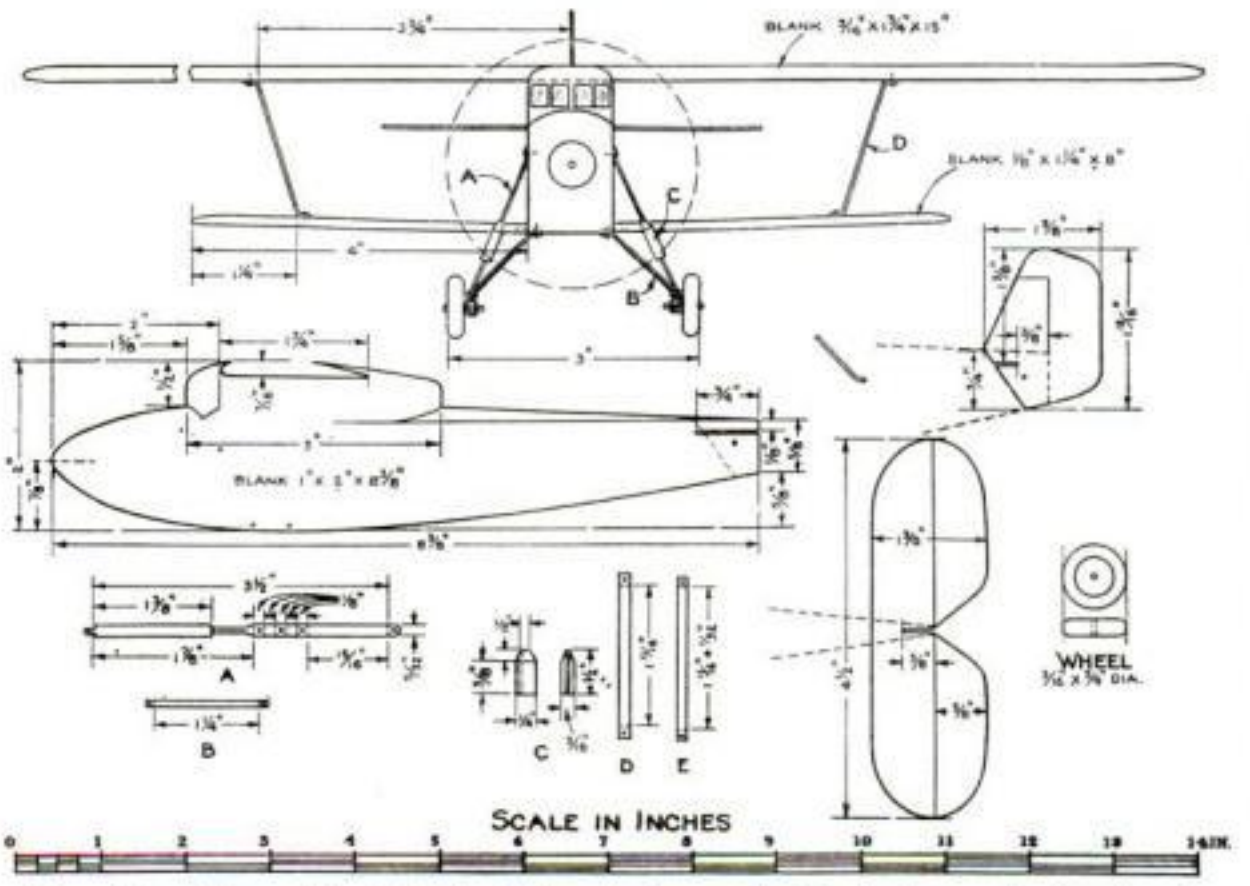
A soft pine blank 1 by 2 by 8⅜ in. will serve for the fuselage. Shape it with a sharp knife and sandpaper, and cut out the wing space with a coping saw. The upper wing, which is shaped from a 3/16 by 1¾ by 15 in. blank, is then inserted into this space and held in place with two brads. Shape the lower wing from a ⅛ by 1¼ by 8 in. blank, cut it in half, and attach to the fuselage with wire pins.

Thin metal is used for the tail units, the 3-in. propeller, and the struts. Follow the dimensions for the struts carefully and bend each on the dotted lines. The shock absorbers are made of wood and are glued to the side landing gear struts in the positions indicated. All struts are fastened in place with small nails. Nine ⅜ in. long sections of ¼ in. diameter bolts are set into the nose of the fuselage to represent the motor.

A suggested color scheme is as follows: Fuselage, light yellow with red top and trimmings; wings, wing struts, and horizontal and vertical tail units, cream; motor, black; and landing gear struts and wheels, red. Of course, the rims of the landing wheels should be painted black to simulate tires.—DONALD W. CLARK.



Side and top views of the Stearman coach. For convenience, the struts are lettered to correspond to the detail drawings below



Front view of the model and details of the soft pine fuselage block, the metal tail units and struts, and the wooden wheels and shock absorbers. Make the 3-in. propeller from sheet metal

Copyrighted material

FORMULAS FOR MIXING SPECIAL FINISHES IN HOME SHOPS

IT IS often necessary to prevent glare and reflection from metal and glass parts, especially tubes used for optical instruments. To prepare a dull black varnish for this purpose, thoroughly wet dry lampblack with denatured alcohol and knead the powder to break up all lumps. Then add a little shellac varnish —just enough to act as a binder. Stir thoroughly and filter or strain through cloth. This makes an excellent black varnish for use on glass, metal, composition, or cardboard. If the varnish, when dry, has any trace of shine, it is an indication that too much shellac has been used. This defect can be overcome by adding more lampblack and denatured alcohol.

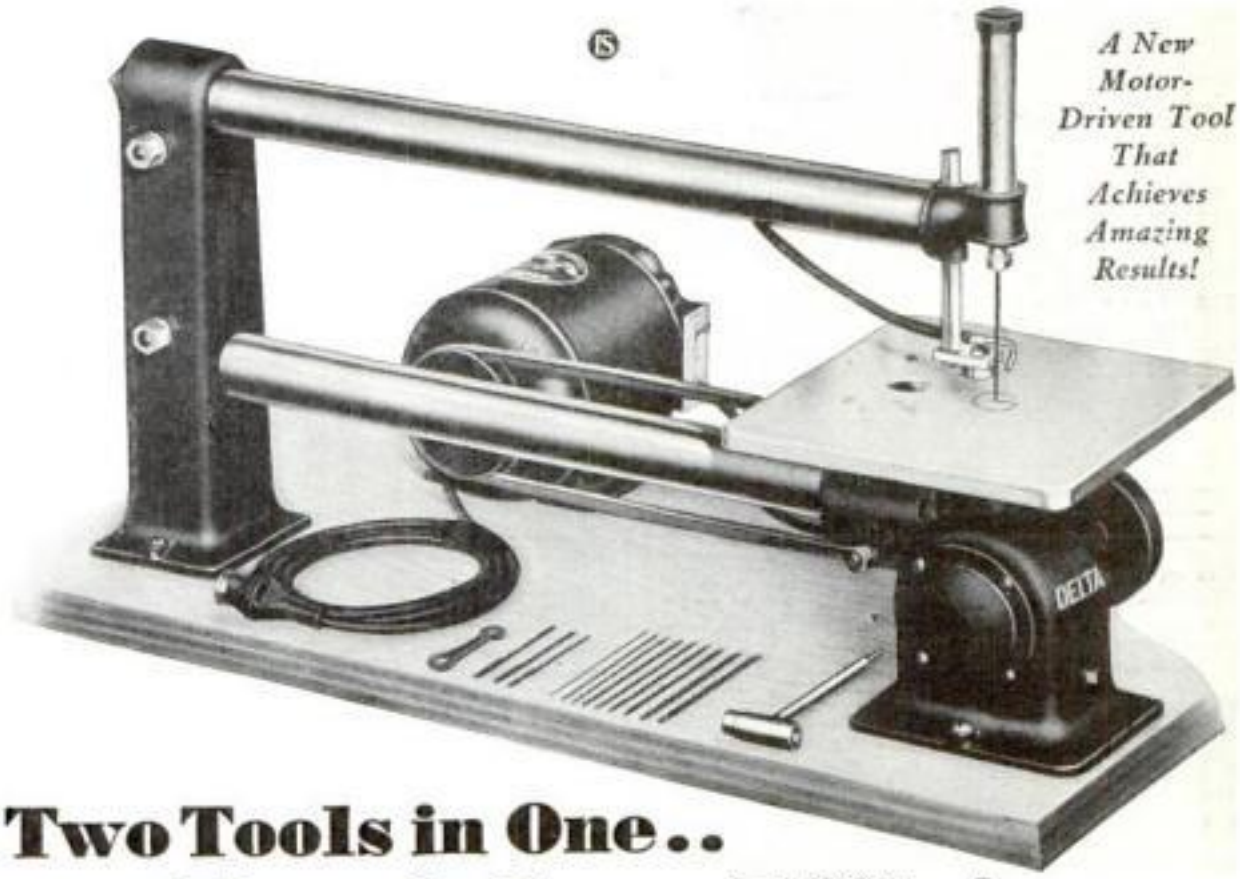
If, on the other hand, a glossy black surface is desired for metal or glass, or even cardboard, use plenty of shellac. Asphaltum dissolved in benzol also gives a glossy black surface which can be used on any material. The latter can be made more or less flexible by the addition of a few drops of linseed oil.

Inexpensive but wear-resisting colored varnishes are often needed for toys and novelties of various kinds, and it is important that the colors dry quickly and be glossy and brilliant. Dry colors are obtainable at large paint stores in various shades of brown, red, yellow, blue, and green, and all that is necessary is to mix sufficient of the dry pigment with shellac to give the desired shade and intensity. If necessary, thin the mixture a little with denatured alcohol. If only small quantities of the colors are required, watch glasses or the tin tops of mayonnaise jars can be used as containers for mixing the colored varnish. Do not mix more than the quantity needed for the job in hand.

THE difficult feat of staining wood a permanent, durable jet black color can be accomplished by using two solutions. The first consists of a mixture of 1 oz. copper sulphate and 1 oz. potassium permanganate (or, if the permanganate is not at hand, 1 oz. of potassium chlorate), dissolved in ½ pt. water. The second solution is made by pouring 1½ oz. concentrated hydrochloric acid slowly into ½ pt. water, stirring well, and then adding 1 oz. aniline (oil). Heat the first solution to the boiling point and brush it on the clean wood. Let this dry, then apply a second coating of the hot solution. When this is dry, the aniline solution is brushed on cold. A second coat is applied when the first is dry. After this has dried, sandpaper the wood lightly and wipe with a rag. Then wash the wood thoroughly with clean water to remove all excess chemicals. When the wood is again dry, sandpaper it smooth. The final appearance of the wood will be that of black ebony.

For a dull finish, rub with a mixture of equal parts of boiled linseed oil and turpentine. For a high polish, use shellac in the same way.—H. B.

New Scroll Saw Pleases Woodworkers!



A New Motor-Driven Tool That Achieves Amazing Results!

Two Tools in One.. *has* Band Saw Efficiency

Delta Quality Motor-Driven Woodworking Tools

Save you time, money, and labor. They take all the drudgery out of woodworking—enable you to turn out better work in a fraction of hand time. Quickly pay for themselves. Used and recommended by thousands of home workshop owners, carpenters, contractors, farmers, and factories.

New Delta DRILL PRESS

Large capacity. Ball-bearing spindle. Automatic leveling, accurate tilting table. Many special features—an unusual value.

New Delta BAND SAW

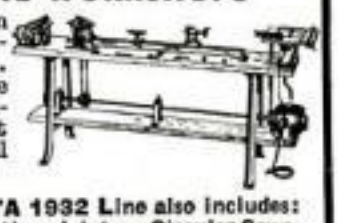
Smooth running, efficient, safe. Ball-bearings throughout—including the blade guide. Fully guarded in every way. Graduated tilting table. Surprisingly low priced.

COMBINATION UNIT

Circular Saw, Jointer, Mortiser, all mounted on convenient, portable stand. Each tool can be operated separately or all together. No interference.

COMPLETE WORKSHOPS

All mounted on bench or convenient stands . . . available in large variety of combinations and at prices to fit all needs.



Complete DELTA 1932 Line also includes: Woodturning Lathes, Jointers, Circular Saws, Moulding Cutters and many new accessories.

DELTA SPECIALTY CO.
(Division of Delta Mfg. Co.)
3775 N. Holton St., Dept. B-132, Milwaukee, Wis.

THIS NEW, moderately-priced tool is **radically different** from any Scroll Saw on the market. Runs at **full motor speed**—1800 strokes per minute—with all springing and twisting eliminated, with perfect balance and **absence of vibration!** As a result, this remarkable tool produces fine, smooth and accurate work hitherto only possible on a bandsaw. Has 24-inch throat capacity and it will **saw wood 2 inches thick!**

Works on metal and fibre as well as wood. Has numerous special features. Can be used for filing, sanding, and honing. Send coupon for free Catalog telling all about this amazing new tool!

Delta Quality Pays in the End

Delta motor-driven tools are built to be efficient, convenient, and practical **in actual operation.** Fine quality workmanship and materials are used throughout even where they cannot be seen. That's why woodworkers the country over say: "Delta offers the most machine value per dollar."

10 Day Trial

EASY TERMS

Delta Tools are always available for a 10-Day Trial without the slightest risk. Satisfaction is guaranteed. For full details of this liberal offer, and also of convenient Easy Payment Plans on larger outfits, send the coupon below TODAY!

CATALOG FREE!

Send today for this Big Illustrated Book crowded with valuable information for the woodworker—professional, spare-time or hobbyist. Shows the complete 1932 line of Delta Motor-Driven Tools. Send the coupon NOW!

DELTA SPECIALTY COMPANY
(Division of Delta Mfg. Co.)
3775 North Holton Street, Dept. B-132
Milwaukee, Wisconsin

Please send me, without obligation, 1932 Delta Catalog. Also send full details of your 10-Day Trial Offer and Easy Payment Plans.

Name.....

Address.....

City..... *State*.....

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS ... See page 8

Copyrighted material

NOW—Electrify Your Favorite Clock This Low-Cost EASY WAY

Don't part with your favorite clock because it no longer keeps good time. The New Hammond Electric Clock Kit will electrify it simply and permanently—thus adding to the beauty of an old or favorite clock the accuracy of modern electric operation. Anyone can make this installation with just a few common tools and this new kit—which contains every single part necessary for the job, including the mechanism, a free folder of instructions, special adjustable brackets for permanent mounting of the mechanism and 3 differently sized sets of hands, fitting any clock face from 3" to 9-¾" in diameter. Free repairs on mechanism guaranteed for a year by The Hammond Clock Company.

SPECIAL PRICE—Usually sold through stores for $9.50, this kit is now offered direct to Popular Science Readers for only $3.95—and you need send no money now! Here's a real Christmas Gift for a handy man!

The Hammond Clock Company P.S. 1-32
2915 N. Western Ave., Chicago, Ill.

☐ Send me the New Hammond Electric Clock Kit. I'll pay the Postman $3.95 plus a few cents for postage when he delivers it.

☐ Send FREE pamphlet "How to Electrify a Clock."

Name.....

Address.....

Make Beautiful CABINET WORK Furniture at 1/10 STORE COST

L-112

Our Illustrated Catalog Prices Hundreds of Items

Domestic, Foreign, Lumber—Burl, Crotch, Diamond Matched Veneers—Inlay Woods, Bandings—Many Styles Carved Turned, Fluted and Twisted Legs—Cabinet Hardware—Tools, Machinery and Supplies.

SOLID MAHOGANY or Walnut 28" Turned—Fluted and SANDED Legs 55¢ Each
See L-106

Our large, new 44-page catalog is just off the press. Send 10c in coin or stamps to cover postage and wrapping. Credited on first order.

Inlay bandings 15c a yard up. 20 different woods, ⅛" x 2½" x 3". Beautiful assortment, all labeled, only..... **$1.00**

CRAFTSMAN WOOD SERVICE COMPANY
We Ship All Over The World
7354 Vincennes Ave. Chicago, Ill.

L106

Start a Work-Shop At Home

Parks woodworkers are famous money-makers. Begin with small unit as shown in cut and build up to fully equipped shop. Complete catalog on request.

THE PARKS WOODWORKING MACHINE CO.
Dept. PS-1
1525 Knowlton St.
Cincinnati, Ohio

PARKS
WOODWORKING MACHINES

SHIP MODEL FITTINGS

Extensive line of quality fittings—for sailing ships, whalers, steamships, destroyers, yachts. Single and double boxwood blocks; dead eyes; oars; water buckets; belaying pins; stanchions; propellers; anchors; etc., etc. Complete metal fittings for Destroyer Preston. Electric motors. Blue prints for Capt. McCann for Yacht Diana. Complete construction sets for many models. Send 15c today for big, illustrated catalog.

A. J. FISHER
1002-2 Etowah Ave.
Royal Oak, Mich.

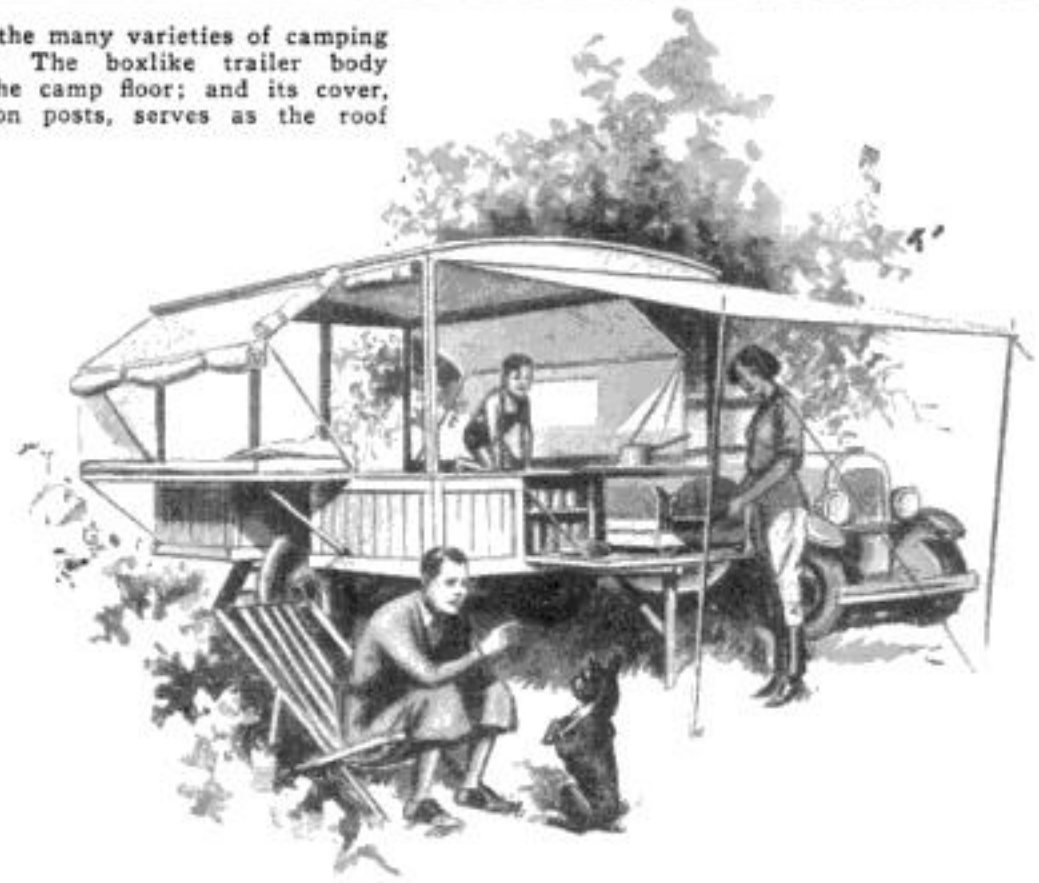
CATALOG 15¢

You Can Print

Cards, Stationery, Circulars, Labels, Advertising, etc. Make nice profit in either spare or full time. Do popular Raised Printing like Engraving with any of our presses.

Do Your Own Printing

Save money. Easy rules furnished with every outfit. Pays for itself in short time. Junior press $5.90, Job press $11 up, Power $149. Send for free catalog of outfits and all details. **THE KELSEY Company N-33, Meriden, Connecticut.**



One of the many varieties of camping trailers. The boxlike trailer body forms the camp floor; and its cover, raised on posts, serves as the roof

$100 *Cash Prizes Offered*

FOR THE BEST PLAN OF A

Camping Car Trailer

HAVE you ever wished that you owned an ideal camping car trailer—a trailer that would give you the freedom of the broad highway to go and camp where you pleased? Perhaps you already have a clear idea of how you would construct the running gear and body of the trailer, and how you would arrange the bunks, build the kitchenette, and provide those many other little conveniences that make vacation days so much more enjoyable.

A friendly competition among readers as to who has the best and most practical ideas on this subject is certain to develop a number of excellent plans, therefore POPULAR SCIENCE MONTHLY offers the following prizes for designs for camping car trailers:

First prize	$ 50
Second prize	25
Third prize	10
Fourth prize	5
Fifth to fourteenth prizes, $1 each	10
Total prizes	$100

Sit down now and sketch out your ideas for constructing such a trailer. Make your drawings as clear, understandable, and complete as possible. Then write not more than 500 words describing the trailer and giving in a general way a list of the materials you would use and their estimated cost. Explain exactly why you think your design is well adapted for use by the average small family. Make clear its points of superiority over ordinary trailers for carrying camping equipment.

The trailer may be a relatively small one in which the equipment is packed in such a way that it can be quickly opened out for use, or it may be a larger car of the cottage type with built-in bunks, or it may be anything between the two. In all cases, however, the trailer must itself form an essential part of the camp when set up for use.

It is not required that you actually build the trailer. If, however, you happen to own a satisfactory trailer constructed according to plans which you yourself prepared, you may enter the design in the competition, incorporating any improvements which have since occurred to you. In this case it is suggested that you submit one or two photographs of the trailer and camp, if possible, with your entry.

The drawings do not have to be carefully finished or rendered in the style of a professional draftsman; they may, indeed, be nothing more than pencil sketches, provided they are accurate.

The judges, who will be the automobile and home workshop editors of POPULAR SCIENCE MONTHLY, will base their decision on (1) the convenience and general utility of the trailer as a camping car for the average small family, (2) the simplicity and practicability of the construction, and (3) the cost as considered in relation to the conveniences and comforts provided. In case of ties, each tying contestant will be awarded the prize tied for.

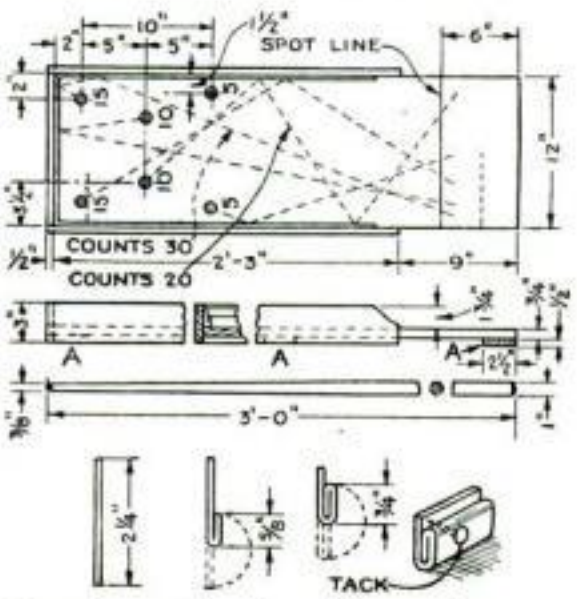
The contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families. Only one design may be submitted by each contestant. Mail all entries to the Camp Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, on or before February 1, 1932.

TABLE GAME DEVELOPS SKILL WITH CUE

ON A MINIATURE scale the game illustrated calls for the delicacy of touch and accuracy of billiards. The board may be made of well-seasoned, quarter-sawed soft pine or other wood that will hold its shape when reënforced by three cleats *A*, screwed on the underside. Lay out and bore the six 1-in. holes ½ in. deep. Fasten the rim strongly with roundhead screws. The cue may be of any straight, hard wood, preferably being supplied with a leather tip.

Green broadcloth or thin felt will improve the playing surface. It should be glued lightly around the edges of the surface and glued or tacked on the edges before the rim is added. Make the cushions of inner tubes, cemented and folded lengthwise and then tacked to the rim of the board in the manner indicated in the drawing below.

The game may be played with marbles, but it is better to use 1-in. celluloid or casein balls. Two or more may play, singly or as partners. Each play consists of four shots, three to play and one spare to be played then or later as desired. Each game may be played as many times round as the players may decide. The players may decide whether the game is to be played "straight shot," in which the ball may be shot directly from back of the spot line into any hole and counted as numbered, or the cushions may be used but not counted. If, however, a cushion shot game is played, a single cushion shot counts the same as the hole is numbered, but a straight shot does not count; a two-cushion shot counts double the hole number, and a three-cushion shot counts three times.—CHARLES A. KING.



How the game board, cushions, and cues are made and typical cushion shots are counted

Latest **BOICE-CRANE** SAW

Tilting and Raising Arbor

Note the full length, rigid and non-binding rip guide. Both sides highly polished.

See the graduated scales—an inch scale for the rip fence and degree scales for the tilting saw and the cross-cut guide. This saw is a time-saver.

BUY NOW PAY LATER

REMARKABLE VALUE AT

$32.50

Here is the saw sensation of 1932—a saw that miters and bevels, yet the table remains level and rigid at all times. The lumber always lays level, regardless of the operation—ripping, cross-cutting, beveling or mitering. Anyone who has ever used a tilting table saw—with lumber slipping and binding at awkward angles will be quick to appreciate the many advantages of this newest BOICE-CRANE development. Highly polished 15"x17½" table; cutting capacity 2½" with 9" saw. Mortising attachment takes ½" square chisels. Also a model with larger table 20"x27½". A solid, substantial and accurate machine in every respect. BOICE-CRANE quality throughout. See our catalog for full description of this unusual saw.

10 INCH Jig Saw $12

Husky, heavy duty machine. Table tilts. Also a 20" Jig Saw.

NEW BALL BEARING LATHE.. $29

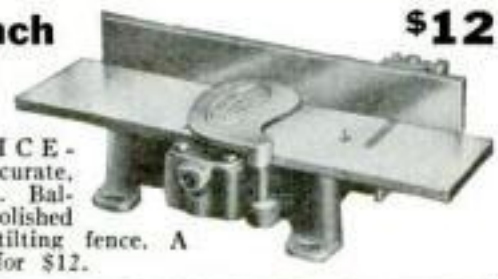
No better lathe built for the price; 11" x 42" Can be equipped with metal working compound slide rest. 7" x 30" Lathe for only $12.

Send for Catalog

Extra large 52-page catalog with big 8½" x 11" pages filled solid with pictures, descriptions and interesting information. Sent anywhere on receipt of 10c coin or stamps (which only pays part of mailing cost). Don't buy before you investigate the new Boice-Crane Line.

W. B. & J. E. BOICE
DEPT. PS-1H
TOLEDO, - - OHIO

NEW 4 Inch JOINTER $12



Another big BOICE-CRANE value! Accurate, powerful and fast. Balanced steel head. Polished tables. Two-way tilting fence. A big jointer value for $12.

Big 3ft. Telescope Five Sections. Brass bound. Powerful Lenses. 10-Mile range. Special Eye Piece for looking at the sun, included FREE. Can be used as a Microscope. Guaranteed. Big value. Postpaid $1.75. C. O. D. 15c extra.
BENNER & COMPANY, T-69, TRENTON, N. J.

FANCY WOODS
We have in stock 50 kinds of hard and soft fancy woods for Inlaying, Models and Scroll work, Mouldings, Inlays and Borders. Send 14c postage for List No. P. S. We also have an illustrated Catalogue describing our designs for Scroll Work, 35 cents.
H. L. WILD, 510 E. 11 Street
Phone ALgonquin 4-6056, New York City

LOOK FOR THE FULL NAME ON THE SHANK OF GENUINE.. Russell Jennings AUGER BITS
AT GOOD HARDWARE STORES
The Russell Jennings Mfg. Co., Chester, Conn.

Build Your Own Dirt Track Racers
or fast road cars. My 25,000 word illustrated treatise tells how to get top speed. Gives world's racing records, contest rules, etc. Describes superchargers, balance, speed, "revs," compression ratios. Be a licensed driver. Treatise postpaid $1.00 C. O. D. $1.12.
Ray F. Kuns, Dept. D, Madisonville, Cincinnati, Ohio.

NOW BUILD FLYING CLOUD!

Here's a beauty, true-to-line, easy to finish! Hull is fully shaped and sanded. 20" model. Set includes blue prints and all parts, complete for $11. Send 15c (coins) for new catalog of fine models and coaches.
Roy Hancock, 323 S. Douglas Ave., Portsmouth, Va.

Build 3 Models for $1.65
Postpaid
Biggest value ever offered: IDEAL 3-in-1 Kit contains everything required to build these 3 Flying Models, including Plans and Instructions. Easy to build.
IDEAL AEROPLANE & SUPPLY CO., Inc.
28 West 19th St. N. Y. City

Ⓢ This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 8

Copyrighted material

Your Chance to learn what MORSE DRILLS will do!

Repeating our special offer of the new Drill Set for 50c

So great was the response from hundreds of readers to this special offer in the November issue of "Popular Science" that MORSE once again offers you an opportunity to obtain for 50¢ (postpaid) the special complete set of six MORSE drills (sizes 3/32" to 1/4").

Throughout the metal working industries of the world MORSE Tools are known and respected for their unexcelled cutting ease and speed, their uniformity and long wear. Now you can bring these MORSE qualities to your own work bench by clipping the coupon below.

The six genuine MORSE DRILLS are carbon steel, straight shank, ideally adapted for use in Hand, Breast or Electric Drills.

Fill out the coupon today, mail to your nearest MORSE dealer or to us, and learn why mechanics everywhere know they can do better work with MORSE TOOLS.

MORSE

TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASS., U.S.A.

Enclosed is 50¢ (in coin or money order) for which send me postpaid your special drill set No. 28 of six (6) MORSE drills sizes 3/32" to 1/4".

Name.....

Address.....

.....

.....

The POPULAR SCIENCE MONTHLY combination boat being rowed, and, at right, the seat and one oarlock

Fitting OARLOCKS *to our* Sailboat-Motorboat

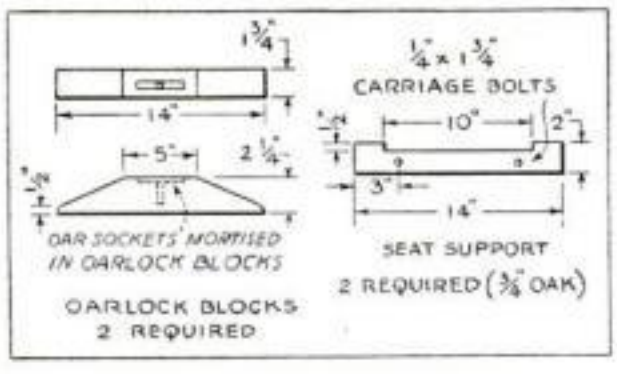
By WILLIAM JACKSON

• IF YOU intend to build a boat this winter and want one that will give you all-around sport, you will make no mistake in choosing our 15-ft. combination sailboat-motorboat *Dauntless*. She is fast and seaworthy when driven by an outboard motor and is better under sail than many boats designed only for sailing. She can be rowed, too, if fitted with oarlocks as described by her designer in this article. You can obtain complete drawings by sending seventy-five cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 131, 132, and 133. Use the coupon on page 110.

POPULAR SCIENCE MONTHLY'S combination sailboat-motorboat *Dauntless*, which was built with great success by a number of readers last summer and is being constructed by many more this winter, can be equipped very easily with oarlocks and a removable seat so that it may be rowed in an emergency. If wind and power fail, oars are worth their weight in gold.

The materials required are: 1 pair oarlocks, North River style; 1 pair 8-ft. oars, ash or spruce; 2 pcs. 1¾ by 2¼ by 14 in. oak for oarlock blocks; 1 pc. ¾ by 10 by 42 in. oak, yellow pine, or spruce for seat; 2 pcs. ¾ by 2 by 14 in. oak for seat supports; 4 carriage bolts ¼ by 1¾ in.; 8 flathead wood screws 1¾ in. No. 8; and 4 flathead wood screws 1¼ in. No. 8.

Make the two seat supports as shown in the drawings and fasten each of them to the coaming between frames Nos. 6 and 7 with two ¼ by 1¾ in. carriage bolts. The seat, which fits in the long shallow notch in each support, will have to be shaped to fit against the coaming. Much of the strain may be taken off the coaming by fastening a small block under the center of the seat so as to rest upon the centerboard well.



Shape the oarlock blocks and mortise them to receive the oarlock sockets. Fasten the sockets flush in the blocks with the 1¼-in. screws. Attach the blocks to the deck about 18 in. abaft the edge of the seat, using four of the 1¾-in. screws in each. Fasten the pins to the oars about 22 or 24 in. from the handles.

Copyrighted material

WHAT LOCOMOTIVE SHALL I CHOOSE?

(Continued from page 96)

English locomotives as prototypes, and some of them will pull a fair sized train a distance of 200 ft. on one winding of the spring mechanism. It is possible to import these locomotives through several agencies in this country, but the duty makes them expensive.

For model railroads in this country, electricity is the favorite motive power. Electricity can, of course, be used to drive a locomotive made to look like a steam engine, and there are, in consequence, a multitude of models available in "O" gage. These range from simple models which are made to conform more or less to electric type locomotives in use in this country and which can be obtained for a few dollars, up to elaborate steam outline jobs costing from $100 to $200. These expensive types are made to order in small quantities, hence the high price. You can also get American-made steam outline locomotives, electrically driven, in either "O" or "standard" gage at quite reasonable prices, and these will do very nicely if you are not too fussy about getting a strictly scale appearance. The colors, including bright red wheels and other queer effects, can be toned down with brushing lacquer or plain paint.

IN THIS connection it may be well to point out that American-made locomotives from the high-grade manufacturers are mechanically fine jobs.

All sorts of compromise effects are possible in the home assembling of locomotives. You can take the motor and chassis of an American type and use it with a home constructed body of an entirely different outline. All sorts of parts also are available, again mostly in "O" gage, so that if you have the necessary skill you can make a scale model of almost any American locomotive.

Passing out of the indoor railroad class to what the English call a "garden railroad," the 2½-in. gage (½-in. scale) is most popular.

These 2½-in.-gage steam locomotives are perhaps the most fascinating of all models to watch in action. The ½-in. scale permits a design and construction that departs from full sized practice only in minor details, and by building ball bearing flat cars and parting his hair in the middle to make the balance perfect, the builder of such a loco can have the satisfaction of actually riding behind his locomotive while operating the throttle with his own hand. It is no trick at all for one of these miniature giants of the rails to haul several flat cars, each laden with a man.

To give you an idea of what you are letting yourself in for if you tackle such a job note the following prices: A complete 2½-in.-gage locomotive finished and ready to run may cost you in the neighborhood of $500. A complete set of machined castings and all materials and drawings would probably run to about $150, or a set of rough castings and drawings would cost you about $50.

The situation with regard to rolling stock for your prospective model railroad is about the same as for locomotives. The American manufacturers list plenty of passenger and freight cars of various types in either "O" or "standard" gage. In "O" gage you can also buy either parts or the finished cars for anything from a flat car to a Pullman observation, all built closely to scale and painted in colors to match their larger prototypes. Prices for complete cars range from about $12 for a flat car to $50 or more for a Pullman.

This is the third of a series of articles on how to get started in model railroading. Following articles will describe the shop equipment and tools necessary for building model locomotives and other rolling stock.

1932 "DRIVER" TOOLS

Get Your Copy
New DRIVER Catalog

Planer $10.00

This new "Driver" 4" Planer helps craftsmen do finer work. Both tables are easily adjusted. Convenient hand wheel allows rapid adjustment for depth of cut. Three-knife cutter head, safety type, provides a clean, smooth, accurate cut. Swinging guard gives complete protection from blades. Overall length, 20". Bronze bearings. No lost power with new efficient V-Belt transmission.

Lathe $5.25

Improved 4-Speed Lathe. Has heavy headstock with bronze bushings, 5/8" Spindle turned down to 1/2" at ends to take "Driver" accessories. Spindle and thrust bearing run in bath of oil. Tail stock has larger control wheel, heavier type. 30" Bed.

When new power tools are added to the "Driver" line it is because "Driver" engineers have developed new features that give the craftsman added convenience and increased accuracy in woodworking. Go to your local store where you can buy the new Lathe, the new Planer and other "Driver" Tools either part by part at not over one dollar each, or a complete machine, as you choose. See all the new tools in operation, or, if more convenient, write us for your free copy of the 1932 catalog.

Let us send you also the first issue of "Driver's" new How-to-make-it magazine, devoted to woodworking—The Home Craftsman. Sells for 10c a copy or one dollar for ten issues. Has new projects you can make. Complete Blueprint, 17"x22", of Bridge Table-End Table. Half-Hour Lathe projects. "Questions & Answers" column. Many other features. Send 10c for first issue.

New "Driver" MAGAZINE
10c

WALKER-TURNER CO., Inc.
PLAINFIELD, N. J.

"Driver" Tools Are Sold by Leading Chain Stores, Mail Order Houses and Hardware Dealers

I buy Driver Tools from

WALKER-TURNER CO., Inc.
Plainfield, N. J. Dept. P. S.

☐ Send my FREE copy of 1932 "Driver" Catalog.

☐ Send first issue of The HOME CRAFTSMAN including 17"x22" blueprint. 10c is enclosed.

*NAME*_____

*ADDRESS*_____

MODEL SHIPS

We can supply construction sets and all sorts of parts such as semi-finished hulls, blocks, deadeyes, special flags, anchors, steering wheels, capstans, figureheads, blue prints, books, etc., for building real fine scale models of the Destroyer Preston, Baltimore Clipper, Flying Cloud, Constitution, Spanish Galleon, Mississippi River Steamboat, Sovereign of the Seas, Bluenose, Mayflower and many others. Also special construction sets for racing sail boats, power boats, model steam engines, propellers, etc., and fine tools for the model maker. Our large 56-page photographically illustrated booklet contains valuable information and hints for building ship models in addition to prices and full description of the above articles. Many people only slightly interested in models have become greatly enthused upon receiving this booklet. A copy will be sent postpaid upon receipt of 15cts. (coin preferred).

Model Ship Supply Co., Dept. R, Mineola, N. Y.

25 POWER $1

GERMAN POCKET MICROSCOPE

A marvelous German 25 power microscope, size of pencil. Enlarges diameter 25 times, area 625 times. Fine lenses give extra large field and great light. Only 4 3-8 inches x 3-8 inch; weighs but 1-2 ounce. Used in schools and colleges thruout the country. Fine for biology, geology, botany, nature study, examining stamps, finger prints, insects, cloth, metals, photographs and thousands of other things. Equipt with handy fountain pen clip.

$1 prepaid. Money back guarantee. Discount for 6 or more.

BINOCULARS Over 200 Glasses All makes- $1- $110

Everything in binoculars, field glasses, telescopes and optical instruments. The finest and largest assortment in America. Catalog gives all information how to choose the best for your individual needs at the LOWEST PRICE.

Try America's leading Binocular House First

DuMaurier Co., Dept. 301, Elmira, N. Y.

GEARS

In Stock—Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 214

CHICAGO GEAR WORKS
769-763 W. Jackson Blvd., CHICAGO, ILL.

Big Value!
BENCH SAW

Here, wood workers is extra big value,—a quality electric driven bench saw at a price you can afford. Just the thing for home work shop, schools, contractors, or production work. Portable; plugs in electric light socket. Grinder, tool rest, extra pulley included. Also furnished without motor. Efficient, accurate, carefully guarded, safe; Arbor ball bearing mounted; 21 big features make this finest machine of its kind at a popular price. Send for literature, and easy terms.

Thomas & Nye, Inc., 176 Dana Ave., Warren, Ohio

CHEMISTS

Catalog Illustrating 2500 Chemist's supplies, 5000 Chemicals, Minerals, Drugs, etc. and listing 1000 scientific books sent for 50c. Glass Still as illustrated capacity of flask 1 Qt. complete $8.00.

LABORATORY MATERIALS CO.
641 East 71st St. Chicago, Ill.

ALUMINUM SOLDER

You can now solder Aluminum, sheet or cast, as easily as tin. Solder Brass, Copper, etc., to Aluminum. Introductory offer $3.00 size sent post paid for $1.50. **Money Back Guarantee.** Manufacturers and repairmen demand it! State Distrs. Wanted. Pays Big Profits. Write Dept. A-1.

AMERICAN SOLDERS CO.
3534 Sunset Blvd. Los Angeles, Calif.

AGENTS MAKE UP TO $15 A DAY

No. 8 Fountain Pen Guaranteed For Life
Has Adjustable Ink Feed and Rubber Sponge

which makes it write better and sell faster than any other on the market. A trial order will convince you. Money Back If Not Pleased. Retails for $1.25, can be sold for 75c and still make over 100% profit.

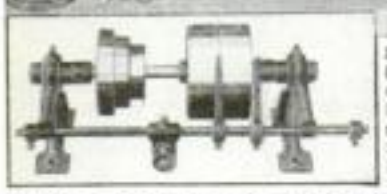
Sample Only 39c

FREE WHOLESALE CATALOG, showing over 1000 fast sellers. Send for your copy now.
SPORS IMPT. CO., 1131 Frank St., LE CENTER, MINN.

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS ... See page 8

Copyrighted material

NEW SOUTH BEND 8 inch Junior $100 AND UP



8 in. x 24 in. Junior Back Geared Screw CuttingPrecisionBench Lathe with countershaft and equipment. $20 down, $7 per mo. Net weight 175 lbs.

A Back Geared, Screw Cutting Precision Lathe

for use in home work shop, auto service, electrical work, tool room, manufacturing, laboratory — in fact for all classes of fine precision jobs.

Note These Major Features

Back geared headstock — cuts threads 4 to 40 per inch—six spindle speeds 43 to 675 R.P.M.—¾ in. hole in spindle — set over tail stock for taper turning — Precision lead screw, ¾ in. diameter — Power feed to carriage — Sold on Easy Payments.

Available in bed lengths 24″, 30″, 36″ and 42″, with plain or compound rest; with countershaft drive and individual motor drive, bench and floor leg types. Can be driven from ordinary lamp socket.

Write for Circular No. 8

describing and illustrating all features of this new lathe, also attachments, chucks, tools. Sent free, postpaid, to any address, Address

South Bend Lathe Works
818 E. Madison St., South Bend, Ind.

Lathe Builders for 25 Years — Over 55,000 in Use

American Flyer Trains

COMPARE!
More Fun Features *and Costs Less* ··

Mail coupon for big, colorful, *free* train book. Plan now to enjoy many years of fun and instructive play. This fascinating book shows you the new electric trains, as low as $5.50, that *outpull* all others. Full brass trim—*Longest* and *heaviest* freight cars made—fun making automatic signals, stations, tunnels, bridges, etc.

In speed, size, realism in total number of pieces, you get more for your money when you buy an American Flyer. Get the catalog and *compare*.

DADS, too, make railroading a hobby

American Flyer Mfg. Co.,
2238S. Halsted St., Chicago.
Send Free Train Book.

Name.....

Address.....

.....

American Flyer Trains

BLUEPRINTS

to Help You in Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. These prints are the result of a pioneer effort begun by this magazine in 1922 to provide readers with authoritative drawings at a nominal price. This service has grown to be by far the greatest of its kind. It is conducted solely for your benefit, so do not fail to take advantage of it at every opportunity.

The blueprints are clearly printed on heavy paper 15 by 22 in. In the following list the blueprint numbers are shown in italic type immediately following the descriptive title. In ordering it is necessary to give only these blueprint numbers. Where the title is followed by one number only, the blueprint is on one sheet and can be obtained for 25 cents. Wherever there are two numbers, it means that there are two sheets in the set, and the price is 50 cents. Three numbers indicate that the set consists of three sheets and costs 75 cents. In a few cases, too, there is more than one project on a sheet. A coupon is given below for your convenience in ordering. When using the coupon, be sure to enter the numbers correctly.

Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*.....3 .50
Combination, 20-in-1, *135-136*..... .50
Lindbergh's Monoplane (3-ft. Flying), *69*.. .25
Rise-off-Ground Tractor, 3-ft., *50*..... .25
Seaplane, Tractor, 30-in., *87*..... .25
Seaplane, Morris (Record 12½ min.), *102*.. .25
Single Stick, Tractor, 30-in., *82*..... .25
Tractor (Record Flight 6,024 Ft.), *104*..... .25
Twin Pusher, Racing, 35-in., *86*..... .25
Winnie Mae (4-ft. flying), *141-142-143*..... .75

Boats

Canoe, Sailing Outfit, *25*..... .25
Outboard Racer, 11½-ft., *128-129*..... .50
Sailboat-Motorboat, Combination (15 ft.), *131-132-133* ..... .75

Furniture

Bookcase, Modernistic, *88*..... .25
Bookcase, Simple, *37*..... .25
Book Ends, Modernistic, *100*..... .25
Bookshelf, Modernistic, *100*..... .25
Bookshelves, Hanging, *77*..... .25
Bookstand, Modernistic, *88*..... .25
Book Trough, *68*..... .25
Broom Cabinet, *49*..... .25
Cedar Chest, Mahogany Trimmed, *17*..... .25
Chair, Rush-Bottom, *36*..... .25
Chest of Drawers, Salem, *39*..... .25
Chests, Treasure, *78*..... .25
Clock, Grandfather, *19*..... .25
Desk, Colonial, *21*..... .25
Desk, Flat Top, *20*..... .25
Desk, Sheraton Writing, *40*..... .25
Dresser, Welsh, *60*..... .25
End Table, Magazine, *68*..... .25
Kitchen Cabinet, *5*..... .25
Kitchen Table Cabinet, *27*..... .25
Lamps, Modernistic, *93*..... .25
Mirror, Scroll Frame, *105*..... .25
Pier Cabinet, *77*..... .25
Radio Cabinet, Console, *70-71*..... .50
Screens, Modernistic Folding, *91*..... .25
Sewing Cabinets, Two, *31*..... .25
Sewing Table, *1*..... .25
Shelves and Lamp, Modernistic, *93*..... .25
Shelves, Corner, *77*..... .25
Smoking Cabinet, *2*..... .25
Stand, Low Modernistic, *100*..... .25
Table, Gate-Leg, *24*..... .25
Table, Sheraton, *38*..... .25
Table, Tavern, *105*..... .25
Table, Tilt-Top, and Bench, *11*..... .25
Table, Tilt-Top, Oak (Top 20 by 24 in.), *140* .25
Tea Wagon, *13*..... .25
Telephone Table and Stool, *18*..... .25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42* .25
Five-Tube (Battery Operated), *54-55*..... .50
Four-Tube (Battery Operated), *43*..... .25
Full Electric Headphone Set, *130*..... .25
One Tube (Battery Operated), *103*..... .25
Screen-Grid Set, *109*..... .25
Short-Wave Converter Unit, *137*..... .25

Ship and Coach Models

Barque, Scenic Half-Model, *108*..... .25
Bottle, Clipper Ship in, *121-122*..... .50
Clipper, Baltimore (8-in.), *92*..... .25
Clipper—*Sovereign of the Seas*, *51-52-53*.... .75
Constitution ("Old Ironsides"), *57-58-59*.... .75
Covered Wagon, *118-119-120*..... .75
Destroyer—U. S. S. *Preston* (31½-in. Hull), *125-126-127* ..... .75
Galleon, Spanish Treasure, *46-47*..... .50
Mayflower (17½-in. Hull), *83-84-85*..... .75
Motorboat, 29-in. Toy, *63-64*..... .50
Pirate Galley or Felucca, *44-45*..... .50
Roman Galley (19-in.), *138-139* ..... .50
Santa Maria (18-in. Hull), *74-75-76*..... .75
Schooner—*Bluenose*, *110-111-112*..... .75
Sedan Chair, Queen's, *123-124*..... .50
Stagecoach, Concord, *115-116-117*..... .75
Stagecoach (Cody), Small, with Horses, *144-145-146*..... .75
Steamboat, Mississippi, *94-95-96*..... .75
Viking Ship, *61-62*..... .50
Weather Vane, Ship Model, *66*..... .25
Yacht, *Sea Scout*, 42-in. Racing, *106-107*.... .50
Yacht, 20-in. Racing, *48*..... .25

Toys

Airplane Cockpit with Controls, *114*..... .25
Birds and Animals, *56*..... .25
Broncho, Doll's House, and Train, *14*..... .25
Doll's House, Colonial, *72*..... .25
Doll's House Furniture, *73*..... .25
Drill Press, Woodturning Lathe, Jointer, and Circular Saw, *113*..... .25
Dump Truck, *101*..... .25
Garage, *29*..... .25
Fire Engine, *101*..... .25
Lindbergh's Plane, *67*..... .25
Play Table, Pullman, *28*..... .25
Sprinkler Truck, *101*..... .25
Tea Wagon, *29*..... .25
Tractor, *101*..... .25
Wheelbarrow, Bunny, *29*..... .25

Miscellaneous

Arbor, Gate, and Seats, *9*..... .25
Baby's Crib and Play Pen, *26*..... .25
Bench Hook, Combination, *30*..... .25
Boring Gage, *30*..... .25
Garage, One-Car, Pergola, *23*..... .25
Log Cabin (Three Rooms), *134*..... .25
Puzzles, Six Simple Block, *65*..... .25
Swing, Porch, *10*..... .25
Tool Cabinet, *30*..... .25
Trellises, Garden, *34*..... .25
Workbench, *15*..... .25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....
No..... No..... No..... No.....
No..... No..... No..... No.....

I am inclosing.....dollars.....cents in payment (25 cents for each number).

Name .....

Street .....

City and State.....

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

Copyrighted material

NEW—EASY WAY *to* Cut Painting Costs in ½!

Now you can be your own painter, do professional work on all jobs easily. Use a Paint-O-Mister—most modern and economical electric spraying unit made. Simple, light and scientifically perfect in every detail. Applies all paints, varnishes, insecticides, etc. Universal Motor, operates on light socket—can be used safely and expertly by anyone. Absolute guarantee—Send Cash, Money Order or $5.00 deposit, balance C. O. D. plus postage. ORDER AT ONCE.

329

NOW **$29.65** Complete

Agents Wanted

H. M. Reynolds & Co.
329 No. 16th St.,
Philadelphia, Pa.

Earn Extra Income at Home

Now in spare hours at home do expert woodworking. Trellis, tables, chairs, book ends, etc. Big demand. New H & A Unit Plan Craftshop gets you started at lowest cost. Five units with quick change motor, SAVES PRICE OF FOUR MOTORS. Buy units as a time or all at once. Easy to learn. Pleasant work. Jointer (illustrated) helps you turn out perfect work—planing, jointing, beveling, rabbeting. Ideal for home or commercial shop. Write today. FREE Catalog. Special Offer for dealers and large jobbers.

801 Park Avenue
HESTON & ANDERSON **Fairfield, Iowa**

The Most Beautiful Ship Model Ever Made—The Barbary Pirate "FELUCCA"

new and now ready. Hull fully shaped and sanded; all parts and accessories supplied cut to fit and ready to assemble. "You Can Build One" for only **$4.50**, and postage. Wonderfully designed and accurately executed, this model, brilliantly colored, is a lasting ornament, and its construction a fascinating pastime. Sent C.O.D. parcel post in U.S. or Canada. Santa Maria, Mayflower, Covered Wagon or Coach Model **$4.50**. Constitution **$6.00**, Flying Cloud **$4.00** or a Spinning Wheel **$1.00**. Send 2c stamp for catalog.

Miniature Ship Models, Inc.
90 King St., Toronto **Dept. NA, Perkasie, Pa.**

The Ideal Xmas Gift for the Boy

LOMARA ULTRA-LOMARA
POCKET MICROSCOPES
Fountain Pen Size
Magnifications: 15 to 1410X

Small, compact and precise, these microscopes are scientific instruments with an excellent optical system—suited for research work in the home, in the laboratory and afield.

Prices $6.75 and up.
Send for booklet P.S. 1.

C. P. Goerz American Optical Company
317 East 34th Street **New York**

MAKE YOUR INVENTIONS PAY

Millions have been made from ideas properly developed and protected by inventors. One of the first steps is the development of a practical working model.
Send us rough sketch or model of your idea. We will submit complete report backed by 30 years' experience in model making. Confidential service. Modern equipment. Bank references furnished. FREE booklet "Making Inventions Pay."

CRESCENT TOOL COMPANY. Dept. B. Cincinnati, O.

FREE Get "B B MAGIC" at once. A wonderful shooter's digest—tells how to hold, aim and handle rifles; helps you to guide others in correct knowledge of guns. Gives facts that make crack shots. Gives safety and common sense instruction parents all like. Sent Free. *WRITE!*

BENJAMIN AIR RIFLE CO.,
673 N. Broadway **St. Louis, Mo.**

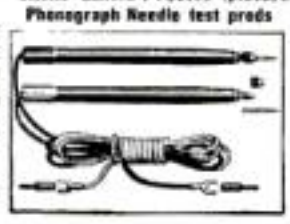
FORMS TO CAST LEAD SOLDIERS, INDIANS, TRAPPERS, Hunters, wild and Farm Animals. 222 Wonderful "True to Life" models. Easy and inexpensive to make. I furnish all necessary material. Send 6c Stamp for Illustrated Catalogue.

Henry C. Schiercke, Ghent, New York

ALUMINUM BOX SHIELD

Genuine "ALCOA" stock, Silvertip finish 5x9x6 high . . $1.89. 5x5x5 Shield . . $1.00 (picture on left).

Phonograph Needle test prods



Always sharp pointed, using Phonograph needles to puncture insulation, corrosion, etc. $1.50 pair. All parts for B.F. 130 and 137. We specialize in radio parts exclusively.

BLAN, The Radio Man, Inc.
Dept. P-1 **89 Cortlandt St.**
New York City

A definite program for getting ahead financially will be found on page four of this issue

YOU CAN TALK AROUND THE WORLD

(Continued from page 69)

filament slightly above normal therefore will not unduly shorten the life of the tube.

If you find, after completing the wiring, that closing the switch and pressing the key produces no sound in the headphones, reverse the connections to the G and F terminals or the P and plus B terminals of the audio transformer so as to get the proper feedback action. Do not reverse both sets of connections, as that will defect the purpose of the change.

You will find, if you analyze this circuit, that it is like the ordinary one-tube regenerative receiving circuit minus the antenna coil and with the primary winding of the transformer taking the place of the usual secondary or grid coil. The secondary winding of the transformer takes the place of the usual tickler coil, so that the tube oscillates at an audible instead of a radio frequency. It is this audio oscillation that you hear in the phones.

My records show that I bought a buzzer to learn the radio code on March 9, 1920, and passed the examination for Amateur First Grade Radio Operator's License on April 24, 1920, which means that it took me a month and a half to attain a proficiency in radio reception of ten five-letter words a minute. Brighter and more adaptable students have done it in far less time than that.

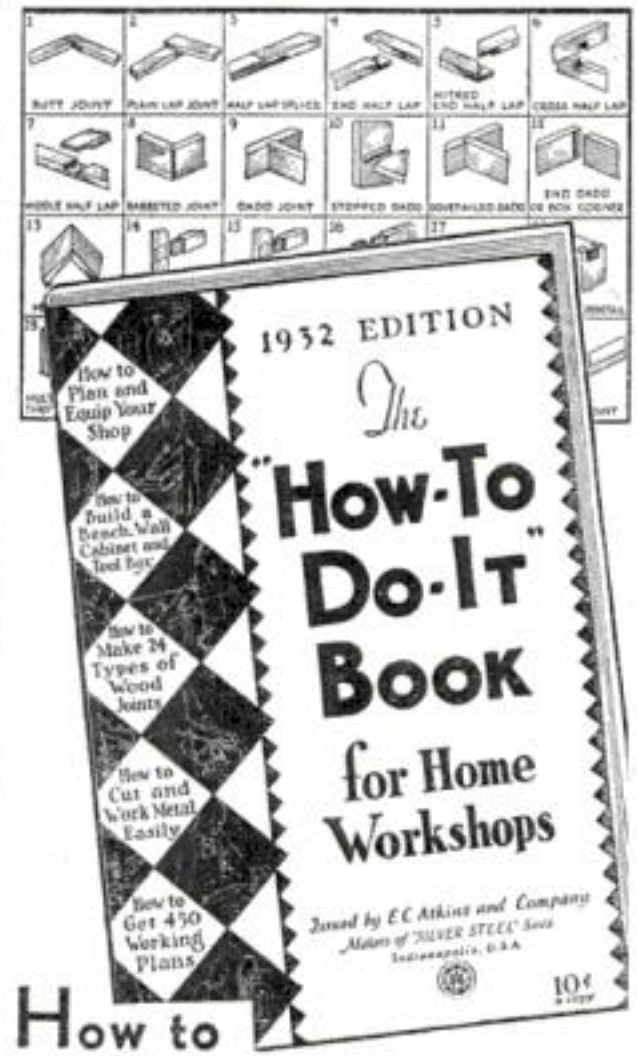
IF OUR readers show that they want it, we will have Mr. Carr continue this fascinating subject of amateur radio with a series of articles showing how to pass the Government examination and how to build simple amateur radio transmitting and receiving circuits. What is your opinion?—The Editor.

SOLVE THE XMAS GIFT PUZZLE

—send your favorite magazine, Popular Science Monthly, to the men on your gift list. We help you by making a reduced rate on gift subscriptions—see page seven

HUMAN BEINGS BREATHE THROUGH THE SKIN

Did you know that you breathe through your skin? Frogs and certain other animals have long been known to obtain in this way a part of the oxygen that they need. But it remained for experimenters at the Harvard School of Public Health, in Boston, Mass., to demonstrate that a man's lungs are not his only source of oxygen. Human beings, their tests show, absorb a certain amount of oxygen through the skin, which in turn "exhales" carbon dioxide. The oxygen is used directly at the spot in the chemical changes of the skin tissue. The amount of oxygen taken in through the skin depends upon the oxygen content of the blood, skin breathing being less as the amount of oxygen in the blood rises, and greater as the blood oxygen falls. The Harvard experiments suggest that the functions of the skin are more numerous and varied than was formerly conjectured.



How to Cut 24 Joints

WITH this new book at your elbow, you'll find it EASY to make perfect-fitting joints of the types used in home shop wood-working.

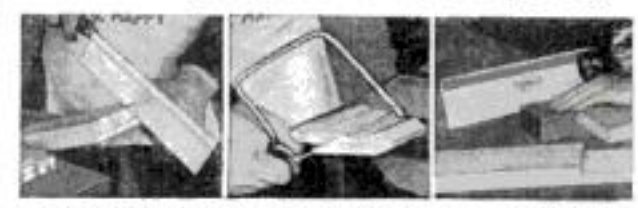
It's like taking a short course in joinery, to study the nine pages of pictures and step-by-step instructions which a veteran craftsman gives you in this chapter on joints.

First, he explains the uses of 24 common wood joints, and tells you exactly how to make each type—butt, lap, rabbet, dado, mitre, mortise-tenon, dowel, dovetail, matched, coped, etc.

Next, he shows you how to use these joints in building a bench, table, tool box, cabinet, saw-horse and other shop fixtures. Then, comes a feature no other book offers—a list of 450 things to make, and where to obtain the plans.

That's not all! Other chapters cover . . . laying out a new shop . . . selecting tools and machines . . . choosing woods . . . new ways to cut metals . . . and so on! Lastly, are eight pages of facts on saws, showing types for every wood or metal-cutting job in a shop—all made of the world-famous ATKINS "Silver Steel." Send the coupon for this new 40-page home-shop handbook.

This book with a set of tools and an Atkins Junior Mechanic Saw, is a great Christmas gift for your boy.



ATKINS SILVER STEEL SAWS

E. C. ATKINS and Company *(Est. 1857)*
428 S. Illinois Street, Indianapolis, Ind.

I enclose 10c for the ATKINS How-To-Do-It Book.

Name . . . . . (PRINT)
Street . . . . . .
City . . . . . State . . . . . .
My dealer is . . . . . .

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS . . . See page 8

Copyrighted material

Be Independent!
Have Your Own Business

Sharpening lawn mowers by the Foley Electrakeen System gives you 99c PROFIT out of every dollar you take in. It is the chance of a lifetime for you. Here's exactly the thing you've been looking for, to make a clean-up this summer and have a well established business of your own. *Morse made $1520 in five months last year!*

Foley Electrakeen Lawn Mower Sharpener

This remarkable machine sharpens all kinds and sizes of lawn mowers by the same method used by leading lawn mower manufacturers. Does a perfect job in from 15 to 20 minutes, sharpening all blades and the cutter bar at the same time. You get $1.00 to $2.50 a job—$3 to $5 an hour, and most of it CLEAR PROFIT!

These Men are Making Money

J. H. Harbeck writes, "Last year I ground 1289 mowers." R. E. Linkfield says, "I average 15 mowers a day, and people bring them from all over" . . . "Made enough money to pay for the machine and all expenses in three weeks," writes Walter Dambek.

Why don't YOU make BIG MONEY, too? Get started early. FREE PLAN tells you how. Send coupon TODAY!

Mail This Coupon NOW!

Foley Manufacturing Co.
1082 Foley Bldg., 11 Main St. N. E., Minneapolis, Minn.
Please send me FREE PLAN and tell me how I can make BIG MONEY with the Foley Electrakeen Lawn Mower Sharpener.

Name .....

Address .....

ELECTRIFY YOUR OLD CLOCK *do this at home with* **Amazing New Invention**

Write for FREE TRIAL Offer

Write today for details of FREE TRIAL offer and our free literature telling all about this wonderful new invention that now enables you—or anyone—to easily and quickly turn that beautiful old clock you prize so highly—(or any old clock)—into a guaranteed electric clock at an amazingly low cost.

Unconditionally Guaranteed

With our simple easy instructions, anyone can install this amazing invention AT HOME. No electrical experience or special ability needed to make ANY old clock give accurate NAVAL OBSERVATORY TIME all the time with no more winding, no noise and no repairs.

AGENTS earn $4.99 a day Spare Time

Write for Free Literature

Special Introductory Price Special low price now . . . also special User Agent's proposition. Every home an easy sale. Good profit margin . . . $4.00 a day—even in spare time—an easy income. Write for complete details—hurry before special offer closes.

ROBERT BARCLAY, Inc., Dept. 13-61
849 W. Washington Blvd, Chicago, Ill.

INSURANCE FOR 10,000 HAZARDS

(Continued from page 33)

charged, you can easily figure out the chances of your house burning. If it is ten cents on a hundred dollars, the insuring company calculates the odds are 1,000 to one against fire. If it is twenty cents, the chances are 500 to one.

Life insurance, with the same basis throughout the country, is based on the age of the applicant. How long the average person of a certain age will live is calculated from the mortuary, or life expectation, tables.

THE first table of this kind was compiled in 1693 by Edmund Halley, the discoverer of the comet that bears his name. A century and a half later, the historic "Seventeen Offices Table" appeared in London. It derived its name from the fact it was based on 83,905 policies issued between 1762 and 1833 by seventeen British life insurance companies. For years, it was accepted as the standard in America. Then, in 1868, Sheppard Homans, of the Mutual Life Insurance Company in New York City, published his famous "American Experience Table," used by actuaries to this day. Because mortality in youth has been greatly decreased in recent years, many experts believe a new table will soon have to be worked out.

Tracing the law of averages is usually a matter of carefully compiled statistics. But finding the average is only the starting point in the actuary's work. Then comes reckoning the element of probability, the "plus or minus variation" which may be expected from these tables. It is this that takes him into the realm of higher mathematics.

One day, during the reign of Louis XIV, two noblemen were playing cards when they were interrupted. Each had wagered thirty-two pistoles on the outcome of the game, to be won by the first to get three points. One gamester had one point, the other two, when the playing ended. How should they divide the stakes? Because they couldn't decide, a great mathematician turned his attention to the realm of chance and later formulated the law of probabilities.

THE players took their problem to Blaise Pascal, the famous philosopher and mathematician. "If," he said, "one more hand had been played, one of two things would have happened. The player with two points might have won, had three points, and taken all. Or the player with one point might have won, giving each two points and making the game a draw. The man with two points can't lose his thirty-two pistoles. The other may lose his or retain them, the chances being even." So he separated the wager of the player with one point into two equal parts and gave his companion one half, thus settling the controversy by giving the player with two points forty-eight pistoles and the player with one point sixteen. This was the first of many decisions based upon the probable course of future events.

In England, not long ago, a newspaper held a beauty contest. Fifty girls from different parts of the country reached the finals. From these fifty, judges were to pick twelve, each of whom would receive a prize. One contestant later sued the paper, proving she had not received notice in time to attend the final contest and demanding damages equal to one of the prizes. The lawyer for the paper declared there was no proof she would have won if she had been present. The judges deliberated and finally handed down a decision that as there were fifty contestants and twelve prizes, by the law of averages, each contestant's propects were worth twelve-fiftieths of a prize. This amount the girl was awarded.

The difficulty of figuring out probability increases rapidly with larger numbers. Offer a person his choice of two books and you have an even chance of guessing which he will take. Offer him seven novels and five biographies, letting him select one of each, and he may take biography number one and any of the seven novels, biography number two and any of the novels, etc. He will have thirty-five possible choices, and you have one-thirty-fifth chance of predicting his choice.

Take another case. A table is laid for eight people. In how many ways can they take their places? The surprising answer is 40,320. If a boat club with fifty rowing members has one eight-oared boat, the number of ways in which the crews can be arranged reaches the amazing total of 21,646,947,168,000! It is no wonder that actuaries, dealing with probabilities in groups of hundreds of thousands, have to resort to higher mathematics!

WHEN you get the announcement that your insurance premium is $89.31, do you ever wonder where the one cent comes from? Is it merely tacked on for good measure? Not at all. Back of it are acres of paper carrying the figures by which actuaries, starting with the average and working out probable variations, considering interest rate and the thousand and one intangible forces that influence the world of finance, have come to their painstaking conclusion.

Probably no other printed document, with the exception of the Bible, is kept among the treasured possessions in as many homes as the insurance policy. Yet, few people ever read policies through. After paragraph three, the usual owner wants to know: "In Heaven's name, why don't they print this so somebody can understand it?" Why *are* policies written in such technical language? Well, here's one answer:

A few weeks ago, a man in Brooklyn, N. Y., applied for accident insurance, giving his occupation as "real estate dealer." Investigation showed he had several houses for sale and insurance was granted. Shortly afterwards, he was slain by New York gangsters. It developed he was really a bootlegger and the company had been carrying a risk it had never meant to assume. Yet, because the policy read "real estate dealer," and it was proved he had sold a house or two, the company had to settle with the heirs. If it had read: "real estate broker," the fact that he had no license would have made the policy invalid. In a policy, every word is important. The exact meaning is considered from the legal angle, so that skilled word-twisters in court cannot construe what is not meant.

A QUESTION that has started scores of insurance misunderstandings is: "When is a fire a fire?" If a lighted candle sets your curtain ablaze, you can collect damages. If a dropped cigarette burns a hole in your valuable rug, you cannot. Why? The distinction goes back to a court decision resulting from a flood in a western city.

In the warehouse of a large woolen mill, thousands of bales of wool were under water for eight days. When the flood subsided, the bales began to steam and smoke, smouldering with spontaneous combustion. The fleece, too hot to handle, was spread out to dry and stirred with pitchforks night and day. But in spite of every effort, the fire ate its way through the fibers, destroying the wool, although never bursting into flame. The company reported loss by fire to its insurance brokers but the insurance company refused to pay. *(Continued on page 113)*

INSURANCE FOR 10,000 HAZARDS

(Continued from page 112)

Finally the U. S. Circuit Court of Appeals handed down a decision against the woolen mill.

"Mere combustion," it declared, "will not support a claim for loss unless it is sufficiently rapid to produce ignition. Combustion causes a haystack gradually to decompose and a tree in the forest, when it is thrown to the ground, in the course of years to molder away. Still, we never speak of these processes as fire. And why? Because the process of oxidation is so slow it does not produce a flame. . ."

Rust is slow fire. Yet nobody can collect fire insurance on rust. There must be a dividing line somewhere, and the court decided that it is the instant flame appears. Then, according to the meaning of most insurance policies, a fire is a fire.

A FUNDAMENTAL difference between life insurance and property insurance is another source of misunderstanding. When the holder of a $10,000 life insurance policy dies, his heirs get $10,000. When a house insured for $10,000 burns down, the owner may receive only $7,000 or $8,000. All property insurance is based not on the face value of the policy, but upon the cost of replacing what is lost. If the house is built when materials and labor are high and burns when they are low, the structure can be replaced for less than the original cost, and this is the basis of the insurance award. Occasionally the opposite is true, and more is received than was originally spent.

The principle also applies to furniture. "If I have $1,500 insurance on my furniture and it all burns up, don't I get $1,500?" The answer usually is no. You get what it would cost to buy similar furniture in the same condition as yours. For this reason, it is important to keep an inventory of household furnishings, with the price paid and date bought.

Inventory books, that start with the front door and skip nothing, can be purchased at a nominal cost in bookstores. With such an inventory, you have an exact basis for presenting your claims in case of fire. The date of purchase is important because depreciation is always taken into account by insurance companies.

A year ago, a friend of mine bought a new six-cylinder sedan. Last summer his wife was out driving when a freak hailstorm swept over the country. Balls of ice as big as eggs crashed down, riddling the top and ruining the fenders and hood. Looking up his insurance, he found he was covered for damage by hail. He called up the company.

"Take the car to a garage and have a new top, fenders and hood put on," they told him, "and we will pay seventy-five percent of the cost."

"But why should I pay twenty-five percent?" he wanted to know.

THEY explained that the basis of payment is the present value of the automobile. As the car was nearly a year old, its value had depreciated twenty-five percent. Since the whole machine was worth only seventy-five percent of its original cost, each fender and part was worth only seventy-five percent of its cost when new. This is fair, they pointed out, as the premium paid decreases from year to year as less insurance is allowed on the machine.

In America, every thirty-one seconds there is a serious auto accident; and every sixteen minutes, night and day, someone is killed by a motor vehicle. Financial responsibility laws, requiring all drivers to carry auto liability insurance, have been passed in eighteen states. Yet, few drivers of automobiles have a clear understanding of their obligations and responsibilities. Many think, for instance, that if someone runs directly in the path of their machine, they are automatically absolved of blame for the accident. This is often far from true, as is illustrated by a recent incident in Georgia.

A bus stopped by the side of the road to let off a schoolboy. He dashed around the back and onto the road just as a car was coming at slow speed from the other direction. The machine did not even hit him. He ran *into it*, striking it about even with the driver's seat. Yet the operator was held responsible for the accident on the grounds that when the bus stopped he should have anticipated someone might run out from behind.

The so-called "Subrogation Clause" in automobile protection is another part of insurance rarely understood. It allows the insuring company to sue the other party of an accident in your name, in order to get back the money it pays you. Its original purpose was to prevent a policyholder from collecting insurance and then suing the other party for additional damages.

In Massachusetts, a few years ago, a man was driving at about twenty-five miles an hour along a concrete highway. Going in the opposite direction, a "road hog" swung out of line at high speed, came clear over on the left-hand side of the road and, unable to get back in line, crashed into him. His insurance company paid the damages and then sued the "road hog."

Through an extraordinary quirk in the law, this apparently clear case was decided against them. It seems there had been an error in the factory number in the registration of the injured man's car, and because it contained an incorrect number, the court declared it was improperly registered and was a "trespasser and nuisance on the highway!"

IN CONCLUSION, here are "Ten Points for Policyholders" suggested by a veteran who has handled insurance of all kinds for thirty years. If they are followed, much of the grief and misunderstanding connected with insurance will be avoided.

I. Make an inventory of everything in the house and know the cost of each article.

II. Keep this inventory and all policies in a vault or safe, not around the house where they may be destroyed.

III. If your insured auto is damaged, have it towed to a garage but do not have it repaired until seen by a representative of your insurance company.

IV. If you make alterations in your home requiring more than fifteen days, get an extension from your insurance agent. Otherwise, if a fire starts after the fifteen days, you are not covered.

V. If you are hard up, don't put a mortgage on your furniture without letting the insurance company know. It voids your policy.

VI. See that your auto policies have the number of the machine correct and that your other policies are correctly made out.

VII. In case of an auto accident, get names and addresses of all witnesses and a diagram of the scene immediately. In all cases involving insurance, notify the company promptly.

VIII. When you move, don't forget that your furniture is not covered unless you get a special clause from your agent. And if you lend a piano for the Fireman's Ball, remember it is not insured away from home.

IX. In case of fire, you can clean up the débris into piles but do not destroy it before the insurance representative comes.

X. And finally, read your policy. If you don't understand all the terms, go over them with the local representative until you do.

TELEVISION, TALKING PICTURES

Dissatisfied with your present job? Not making enough money? Then let me show you how to prepare for a real job at a real pay, in RADIO—one of the fastest growing, biggest money-making trades on earth.

JOBS LEADING TO BIG PAY

Scores of jobs are open to the Trained Man—jobs as Designer, Inspector and Tester—as Radio Salesman and in Service and Installation work—as Operator, Mechanic or Manager of a Broadcasting Station—as Wireless Operator on a Ship or Airplane—jobs with Talking Picture Theatres and Manufacturers of Sound Equipment—with Television Laboratories and Studios—fascinating jobs, offering unlimited opportunities to the Trained Man.

Ten Weeks' Shop Training AT COYNE IN CHICAGO

COME TO COYNE IN CHICAGO AND PREPARE FOR THESE JOBS THE QUICK AND PRACTICAL WAY—NOT BY CORRESPONDENCE, BUT BY ACTUAL SHOP WORK ON ACTUAL RADIO EQUIPMENT. The average time to complete the Course is only 10 weeks. But you can stay as long as you please, at no extra cost to you. No previous experience necessary. Get the facts! Mail coupon below!

Broadcasting-Television Sound Equipment

In addition to the most modern Radio equipment, we have installed in our shops a complete model Broadcasting Station, with Sound Proof Studio and modern Transmitter with 1,000 Watt Tubes—the Jenkins Television Transmitter, with dozens of home-type Television receiving sets—and a complete Talking Picture installation for both "sound on film" and "sound on disk." We have spared no expense in our effort to make your training as COMPLETE and PRACTICAL as possible. Mail coupon for full details!

COYNE IS 32 YEARS OLD

Coyne has been training men since 1899. Get all the facts—FREE! Find out about our Free Employment Service and how some students earn while learning. It costs nothing to investigate. JUST MAIL THE COUPON FOR A FREE COPY OF OUR BIG RADIO, TELEVISION AND TALKING PICTURE BOOK.

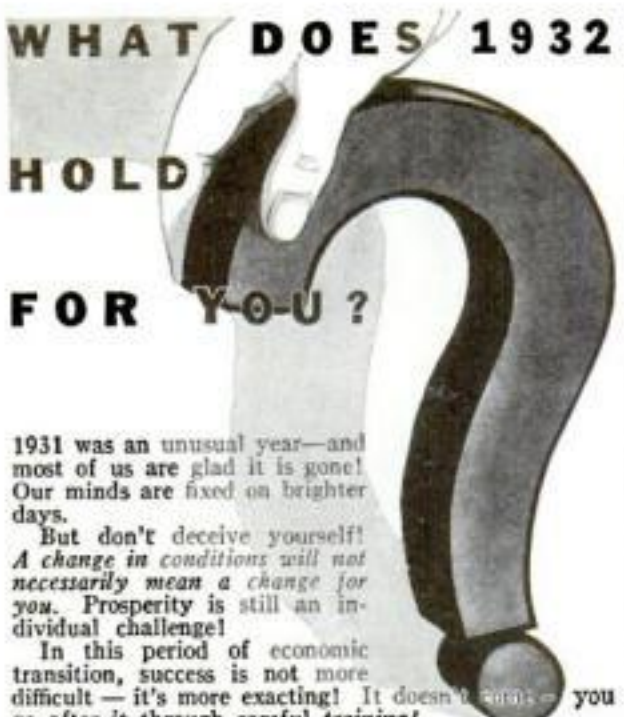
H. C. LEWIS, President
Radio Div., Coyne Electrical School
500 S. Paulina St., Dept. 12-4H
Chicago, Illinois

Send me your Big Free Radio and Television Book. This does not obligate me in any way.

Name.....

Address.....

City.....*State*.....



1931 was an unusual year—and most of us are glad it is gone! Our minds are fixed on brighter days.

But don't deceive yourself! *A change in conditions will not necessarily mean a change for you.* Prosperity is still an individual challenge!

In this period of economic transition, success is not more difficult — it's more exacting! It doesn't [illegible] you go after it through careful *training!*

You can blame the year, curse your luck, wonder what's wrong—one year is like another if you do not make them different! Don't you know hundreds of men who never knew a "good" year?

1932 is new! You can make it the most profitable year of your life. You can lay the groundwork for a career which will furnish more satisfaction and more money. Indeed, 1932 is a golden opportunity for you!

How can you do it? That's easy! Acquire more *training*—do your job *better*, prepare yourself for the *next* job. But doing it is *not* so easy. It takes courage, sacrifice and hard work. Quitters should continue wasting their spare time. Thousands of *fighters*, to get the training they need, are enrolling for International Correspondence Schools Courses. They are going to make 1932 a good year for themselves. So can you! This coupon is a beginning. Mark and mail it—today!

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7604-G, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect
☐ Architectural Draftsman
☐ Building Estimating
☐ Wood Millworking
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Electrical Engineer
☐ Electric Wiring
☐ Electric Lighting
☐ Welding, Electric and Gas
☐ Telegraph Engineer
☐ Telephone Work
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Patternmaker ☐ Machinist
☐ Reading Shop Blueprints
☐ Civil Engineer
☐ Highway Engineering
☐ Surveying and Mapping
☐ Gas Engines ☐ Toolmaker
☐ Diesel Engines
☐ Aviation Engines
☐ Bridge Engineer
☐ Automobile Work
☐ Plumbing ☐ Steam Fitting
☐ Heating ☐ Ventilation
☐ Sanitary Engineer
☐ Sheet Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration
☐ R. R. Locomotives
☐ Air Brakes
☐ Train Operation
☐ R. R. Section Foreman
☐ R. R. Bridge and Building Foreman
☐ Chemistry ☐ Pharmacy
☐ Coal Mining Engineer
☐ Navigation
☐ Agriculture
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Fruit Growing ☐ Radio
☐ Poultry Farming

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accountancy
☐ Cost Accountant
☐ C. P. Accountant
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Lettering Show Cards
☐ Stenography and Typing
☐ Complete Commercial
☐ English ☐ Signs
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Grade School Subjects
☐ High School Subjects
☐ Illustrating ☐ Cartooning
☐ Lumber Dealer

Name..... Age.....
Street Address.....
City..... State.....
Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

DYNAMITE MAKES HARD TASKS EASY

(Continued from page 51)

bottom of the tank. It is now drawn off and sent on another outdoor journey in a trough. Its destination is the neutralizing house where another bath has been prepared for it. This time it is washed in a warm dilution of soda ash. After tests show it to be entirely acid free it is piped to lead containers, from which quantities are taken as required to the dynamite mixing house.

The nitro goes on this trip in little rubber-tired, rubber-lined tank carts pushed by hand. These dangerous little wagons follow carefully prepared paths on which there are no obstructions that might trip the pusher or jar his cart. The man, walking at a slow methodical gait, never hurries. The workmen, I was told, christened these little carts "angel buggies."

WE FOLLOW an angel buggy from the storage tanks to the mixing house. Here machinery was in motion, but running with a subdued hush in keeping with all other activities in this factory of terrific forces. "Here," said my guide, "is where dynamite comes into existence." I saw two large bowls, rubber-lined and about ten feet in diameter. In each stand a pair of belt-driven rubber-shod wheels to which plows are attached.

Workmen weigh out different dry ingredients and dump them into a bowl. Nitrate of soda, wood pulp, cornstarch, ivory nut meal, and chalk are heaped into one and leveled off by a few turns of the wheels. Nitro is now run in and the machinery is started. Around go the wheels with their plows, mixing dry ingredients with the liquid nitro. Crumbs that spill out are carefully swept for fear they might be stepped on and exploded. The mass in the bowl now resembles somewhat oily brown sugar. A sand glass is used to time the mixing and I ask why. It is explained that it is more convenient and equally as accurate as a watch.

The finished batch is dug out of the bowl with wooden shovels and loaded into little cars that carry it to the houses where cartridges are made and boxed for shipment. Following one of these. little carloads of potential destruction, I asked more questions.

I learned that it is no harder to insure workmen in a dynamite plant than it is to cover them in a large steel mill or plant where heavy machinery is fabricated. I was told that accidents in a powder plant are rarer than in almost any other industry. One of the men I had seen watching a thermometer in the nitrator had been with this company for twenty years. Had he ever blundered, I shouldn't have seen him.

"But how do you break men into such jobs?" I asked. "Surely you couldn't put a raw apprentice watching temperatures on the nitrator?"

"No, we can't do that," I was told. "Instead we take a new man and put him at a common job in a safety area. We watch him closely, and if he shows himself careful, obedient, and willing we give him a minor job in a danger area. Step by step he works up to one of the positions you just saw. It's a long road, but we can't take chances."

BY THIS time we were at the packing house. We watched the powdered dynamite taken from the cars and put into a conveyor. This carried it to a hopper at the top of a large cartridging machine. A circular disk rotated, carrying empty shells past a spout at the bottom of the hopper. Loose powder pouring out of this spout is rammed into the paper shells.

The ends of the shells are then sealed and the new-made sticks of dynamite are dipped in paraffine to waterproof the paper around them. The sticks are now packed, in sawdust, in boxes of from twenty-five to fifty pounds weight. These are placed directly in waiting freight cars or stored in magazines until required.

Throughout this plant of sinister potentialities, a visitor senses an atmosphere not unlike that of a church. Men move softly on their rubber-soled shoes. They move slowly, with the measured tread of a deacon pacing slowly down the aisle before Sunday services. Even the machinery is quiet, for wherever possible it is constructed of wood and rubber.

Dynamites are detonating explosives, my guide explains, requiring a combination of shock and extremely high temperatures to set them off. They are safe enough if treated with respect and a proper sense of their latent power. He told me that in one recent year the plant I was visiting had shipped 50,000,000 pounds of high explosives without mishap. In that same year 500,000,000 pounds of explosives were shipped all over the country without a single accident.

UNDER certain circumstances, dynamite can be heated or even burned with safety. Since it is now manufactured so as to be nonfreezing at any temperature likely to be experienced in this country, there is no longer any need to heat it before using it in zero weather. While this explosive is safe at high temperatures, it must be borne in mind that it is then more unstable and will explode more easily than when it is cold.

Dynamite can also safely be dropped sometimes, I was told. A common method of loading some types of deep bore holes is to drop cartridges into them. This often means a fall of over 100 feet. In such holes the cartridge acts like a piston in a cylinder, pushing a cushion of air ahead of it. Very large cartridges are often, however, loaded into holes of large diameter by special tongs.

I learned that there is more to blasting than simply loading a hole and firing it. A good blaster must be a combination of mining engineer, geologist, electrician, and chemist. Each shot must perform a certain function. It must break material into pieces of required size and these pieces must be thrown in a certain general direction; the minimum amount of explosives to do this work must be used.

When preparing a shot the blaster must study his rocks as a carpenter studies the grain of wood on which he is working. Holes must be placed with regard to stratification, so when the shot is fired material will break and fall in the amount and direction required.

THERE is a special kind of explosive for nearly every job. For blowing up coal in dry, well-ventilated mines or in open-face workings, black powder is often used safely. This material has a slow, heaving action that breaks soft material into small pieces. A lot of smoke and gas follow its use, so it cannot be used underground where ventilation is poor.

Straight dynamite is a powerful shattering explosive that is very sensitive. It is used for hard-rock work, such as breaking up boulders and for some quarrying operations. Its fumes prevent its safe use in underground work to any large extent. Gelatin dynamite is used for submarine blasting and some damp underground work. It contains nitrocotton, which gelatinizes its nitroglycerin and waterproofs it.

Gelatin dynamite can also sometimes be used in underground work, like mining or tunneling. Many important harbor developments would have been almost impossible without the aid of *(Continued on page 115)*

Copyrighted material

$1260 to $3400 Year

Men—Boys—18 to 50

STEADY WORK

Paid Vacations

Common education usually sufficient

Mail Coupon Today—Sure

COUPON

FRANKLIN INSTITUTE
Dept. K-281
Rochester, N. Y.

Gentlemen: Rush to me FREE, list of U. S. Government big pay steady positions now obtainable. 32-page book describing salaries, hours, work, vacation and how to get a position.

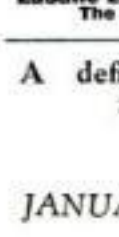
Name .....

Address .....

Wireless (Radio)

and Morse telegraphy taught thoroughly. School, oldest and largest; endorsed by Telegraph, Radio, Railway and Government officials. Unusual opportunities. Expenses low—can earn part. Catalog free.
DODGE INSTITUTE, Hart St., Valparaiso, Indiana.

UNIVERSITY of CHICAGO

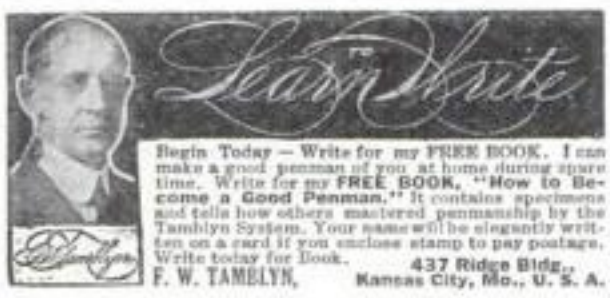


HOME-STUDY COURSES

Continue your high-school, college or personal program of education. Teachers, Religious and Social Workers, Men and Women in many vocations are using the 450 courses in 45 different subjects to obtain guidance by experts for cultural and for practical purposes. The courses yield credit. Ask for free booklet.
THE UNIVERSITY OF CHICAGO
651 ELLIS HALL CHICAGO, ILL.

Wrestling Book FREE

Wrestling taught at home, by mail, by greatest of all world's champions—Farmer Burns and Frank Gotch. Be a wonderful athlete. Handle bigger, stronger men with ease. Learn the secrets of experts, Jiu-Jitsu, Physical Culture. Have perfect health, fame, a perfect body admired by both sexes.
FREE 32 page illustrated prospectus, full of thrilling information, sent free. Tells how we teach expert wrestling at home. Send 2c to cover postage. Write now for your copy. State age.
FARMER BURNS SCHOOL
3391 Courtney Bldg., Omaha, Neb.



Begin Today — Write for my FREE BOOK. I can make a good penman of you at home during spare time. Write for my **FREE BOOK, "How to Become a Good Penman."** It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage. Write today for Book.
F. W. TAMBLYN, 437 Ridge Bldg., Kansas City, Mo., U. S. A.

ELECTRICAL ENGINEERING

A CONCISE, comprehensive course for men of limited time, complete in one year. Mathematics, engineering drawing, shop-work. Students construct motors, install wiring, test electrical machinery. Buildings fireproof. 38 years' successful experience. Catalog on request.

BLISS ELECTRICAL SCHOOL
101 Takoma Ave., Washington, D. C.

BECOME AN EXPERT

ACCOUNTANT

Executive Accountants and C. P. A.'s earn $3,000 to $10,000 a year. Thousands of firms need them. Only 9,000 Certified Public Accountants in the United States. We train you thoroly at home in spare time for C.P.A. examinations or executive accounting positions. Previous experience unnecessary. Training under the personal supervision of William B. Castenholz, A. M., C. P. A., and a large staff of C. P. A.'s, including members of the American Institute of Accountants. Write for free book, "Accountancy, the Profession that Pays."
LaSalle Extension University, Dept. 183-H Chicago
The World's Largest Business Training Institution

A definite program for getting ahead financially will be found on page four of this issue

DYNAMITE MAKES HARD TASKS EASY

(Continued from page 114)

this explosive. The recent deepening of New York harbor, and driving the new water supply tunnel for New York City through miles of solid rock, are examples of its use.

One form of fuse often used for firing powder and some dynamite shots is a cotton or jute filled cord. It looks like a small sash cord. This fuse is only used for firing small blasts in which but one hole is to be shot. It is fired by lighting at one end. For many small dynamite blasts, such as that described at the beginning of this article, electric firing is used. Wires are run from the cap buried in the dynamite to the boxlike contrivance which the workman held at his feet. This is really a small portable dynamo. Its armature is attached by gearing to the handle. Pushing this downward spins the armature, rapidly generating a current that fires the blasting cap and charges.

DYNAMITE of recent years has become such an important tool for farm use that the state agricultural schools of Michigan, Wisconsin, Minnesota, Washington, Oregon, and Idaho have installed regular courses in the use of explosives on farms. In Wisconsin last year approximately 3,000,000 pounds of explosives were used in farming operations. Of this amount nearly 2,800,000 pounds were used by farmers themselves.

Drainage ditches play an important part in farm work. These are now dug by dynamite as quickly and easily as a housewife runs her knife through pie crust dough. A row of cartridges are placed in the ground a short distance below the surface of the line of the proposed ditch.

The first cartridge is then fired, it detonates its neighbor, and the process is repeated on down the line. In an instant hundreds of yards of trench are ripped up in this fashion.

In Canada, on the shores of the Saguenay River, a dam was recently contructed on the river bank because the current was too strong to build it in position. When ready it was dropped accurately in place in the rushing torrent by a charge of dynamite placed under it (P.S.M., Dec. '30, page 26). The wreck of the steamship *Fort Victoria*, sunk near the entrance to New York harbor, was not long ago a menace to navigation. This was a big ship, and dismantling it would have proved a costly undertaking. Charges of dynamite placed on the bottom near the wreck were exploded, digging a huge hole into which the wreck toppled, automatically burying itself (P.S.M., Jan. '31, page 25). Several expert powder men told me that these two operations represented unique uses of explosives.

IN THE Black Hills of South Dakota a monument is being carved by the aid of dynamite (P.S.M., Mar. '31, page 37). Colossal figures of Washington, Jefferson, Lincoln, and Roosevelt are being cut in the side of Mount Rushmore, a mountain of solid granite. Gutzon Borglum, the sculptor who designed this memorial and who is in charge of the execution of it, is employing dynamite to rough out the giant figures.

One of the figures he is cutting in the side of the mountain figures prominently in the history of the industrial application of explosives. It is Thomas Jefferson, who, as far as records show, was the first man in this country to use blasting powder in agricultural work. He destroyed a number of boulders on the lawns of his estate at Monticello, Va., by powder. According to present-day methods of classifying work in explosives fields, destruction of boulders comes under agriculture, making Jefferson the leader in the work of farming with explosives.

PICK YOUR BRANCH OF RADIO

. . . then learn it at RCA Institutes

THERE is no industry more interesting than radio. And the next few years probably will see more happen and offer more prospects for advancement than ever before. With the right training, there may be a future for you in radio.

RCA Institutes offers you that training. Elementary and advanced courses in many branches of practical radio. Founded 22 years ago, today RCA Institutes is America's oldest radio school. In completeness of equipment, instructors, variety of courses it is unsurpassed. In addition, RCA Institutes is directly associated with the largest radio research laboratory in the industry. **Four resident schools**—New York, Boston, Chicago and Philadelphia. **Extension courses** available for those who cannot attend resident schools, with free scholarships for outstanding graduates. Special equipment furnished. All tuition costs moderate.

Check one of the interesting branches of radio you see listed in the coupon below. Then mail it today for general catalog and full information.

RCA INSTITUTES INC.

"Practical instruction in radio and the associated electronic arts."

A Radio Corporation of America subsidiary

RCA Institutes, Inc., Dept. SP-1, 75 Varick Street, N. Y.
Gentlemen: Please send me your General Catalog. I am checking below the phase of radio in which I am particularly interested.

☐ Aircraft Radio
☐ Broadcast Station or Studio
☐ Television
☐ Disc and Film Recording
☐ Talking Pictures
☐ Servicing Home Entertainment Equipment

*Name*_____

*Address*_____

*Occupation*_____ *Age*_____

Copyrighted material

A Bigger Job—
and You're the Man

Are you hunting a bigger job, or does the bigger job hunt you? Why waste priceless years at routine work, when you can acquire at home in a comparatively few months the specialized knowledge for which big firms pay big money? Thousands of men have greatly increased their incomes by home-study business training under the LaSalle Problem Method. Let us show you how you can do just as well or better. The coupon will bring you complete information, together with details of our *convenient payment plan;* also your free copy of a remarkable book—"Ten Years' Promotion in One." Make your start toward that bigger job *today.*

—*Find Yourself Through LaSalle!*—

LA SALLE EXTENSION UNIVERSITY
The World's Largest Business Training Institution

Dept. 183-R **Chicago**

Tell me about your *salary-increasing plan* for my advancement in the business field checked. ☐ Business Management

☐ Modern Salesmanship
☐ Higher Accountancy
☐ Traffic Management
☐ Railway Station Mgm't
☐ Railway Accounting
☐ Law—Degree of LL.B.
☐ Commercial Law
☐ Industrial Managem't
☐ Banking and Finance
☐ Modern Business Correspondence
☐ Modern Foremanship
☐ Paper Salesman's Training
☐ Personnel Management
☐ Expert Bookkeeping
☐ C. P. A. Coaching
☐ Business English
☐ Commercial Spanish
☐ Effective Speaking
☐ Stenotypy
☐ Telegraphy
☐ Credit and Collection Correspondence

Name.....

Present Position.....

Address.....

Learn Autos

in Los Angeles

Come West at Our Expense!

For a limited time we are making a railroad fare offer from any point in the United States to Los Angeles. Just think of it! A trip to California with your railroad fare allowed.

Quickly Train for Big Pay Jobs

Quickly train for Big Pay Jobs in Auto Work. Unlimited Lifetime Employment Service. Employers insist on our men instead of green, half-baked mechanics who don't know what it's all about. You need good training to earn Big Pay!

Don't Worry About Money! We'll Help You!

If you are short of money, we'll help you. We help you secure a part time job to earn living expenses while learning.

It's Easy at National!

Short, condensed training in our Million Dollar Practical "School of Shops" . . . instruction on the most modern equipment money can buy . . . with the country's best staff of expert, experienced instructors. No previous experience needed. None too old or too young to learn. Start any time. WRITE TODAY! We'll send you the full story about Railroad Fare Offer, Unlimited Employment Service, etc. New Book sent FREE.

FREE BOOK

NATIONAL AUTOMOTIVE SCHOOL

Dept. 17-C 4006 So. Figueroa St., Los Angeles, California

A definite program for getting ahead financially will be found on page four of this issue

SHIPS WRECKED FOR THE MOVIES

(Continued from page 30)

In one recent sea picture, in which three American submarines appeared disguised as German U-boats, the dynamite man never pressed a button. The American gunners, knowing the locations of the explosive packages within the barkentine's hull, set them off with their five- and six-inch shells, after first shooting away the collecting board, into which all the smaller wires were run, hanging from one of the masts of the doomed windjammer.

TO SECURE spectacular flames, smoke, and the crackling sound of a real conflagration, the deck and parts of the ship below the deck are soaked with 400 to 600 gallons of gasoline. Then, lycopodium torches, made from the pollen of a flower, are set up behind the gunwales or bulwarks on the deck. Compressed air blowers drive the pollen from these torches onto bits of burning waste, resulting in great bursts of vivid yellow flame, burning with the roar of a real fire at sea. The gasoline, of course, takes fire from these torches. Blowers and ignition for the small pots of waste are operated by another set of electric wires, run through a waterproof and highly insulated cable to a boat that is out of range of the cameras.

There still remain the problems of making the ship appear to be sailing under full canvas even when there is no wind, and of steering herself with no one except "dummies" on her decks and spars. The first is solved by small motor tugs whose masters are well trained in keeping out of the field of vision of the cameras, and whose motors are so tuned down as to be virtually soundless. These tugs remain at the side of the ship away from the cameras, shoving her ahead at such speed as she would make under full canvas, all her sails being set and drawn taut to give the illusion of flight before the wind. When the last moments of destruction come, the cameras and sound receivers are turned off for a moment while the tugs, casting loose, give her a final shove with their blunt noses, leaving the windjammer with enough impetus to carry her another mile or so over the sea.

TO HOLD her straight on this last "voyage," the rudder is set and wheel lashed after her old-time skipper has made allowance for the wind, tide, and current. One such ship sailed nearly twelve miles under her own steering almost in a straight line before she finally was sent to the bottom. If rescues are to be part of the picture, the small crew of actual sailors is taken off before the ship reaches camera range. Then expert divers and swimmers, employed especially for the purpose and dressed in the costumes of sailors, work her guns, if she has any, and leap overboard just before the real destructive shooting begins. They are, of course, picked up, either out of the picture or in it, as the script may order.

Guns of the sailing ship are operated by men before she sails out to be sunk and by electric equipment after her decks have become literally too hot for her crew to remain. In a recent picture, the old *Bohemia,* built in Bath, Maine, by the historic Sewall yard in 1875, carried a two-inch gun mounted in a camouflaged cabin just aft of the base of her bowsprit on the top deck. A gun crew from an American destroyer manned this piece. When the U-boats approached the ship and opened fire, shooting through her rigging and around but not into her hull, this cabin fell apart, revealing the gun, which replied with about a score of shots to the U-boats' bombardment.

Now, the wind-jammers gun was firing blanks. To make for realism, packages containing a few pounds of explosive were floated, each on a large cork, some thirty to forty feet away from and around the hull of each attacking submarine. As the sailing ship fired, the explosive technician, on board the mine-layer *Ortolan,* set off one of these cork rafts of dynamite, erupting a miniature geyser from the sea and giving the illusion of the ship's shells hitting the water. His synchronization with the smoke and a bit ahead of the sound of each shot was remarkable. The floating explosives were connected electrically with a diagrammed switchboard.

After the crew had leaped overboard and had been rescued with many thrills by boats from American destroyers, other guns on board fired several shots, dummies representing their operators. This was accomplished again through electrical connection. Thereafter, the U-boats turned loose their real fighting power, hurling five- and six-inch explosive shells into the sixty-year-old hull. Again the technician stepped in, to set off the lycopodium torches on board by remote control so that, as the shells exploded, the vessel burst into flames and sailed on into the sunset, parts of her rising in terrific explosions now and again as the American gunners searched out her dynamite caches.

WHILE all this was going on, the director, perched with one of several groups of cameramen on the top of the cabin of an express cruiser, was dashing about the location at speeds of twenty to thirty miles an hour. Other cameras were set, until the last moment, on a platform swung twenty feet out from one side of the sailing ship, from the crows' nests of destroyers, and from the pitching deck of one of the submarines.

Sounds of the sea battles are picked up by one of the newest and most important mechanical developments of motion pictures, a sound recording instrument weighing only 200 pounds, divided into sections so that three or four men may carry it. It has its own miniature generator set, which is wheeled about on a hand truck.

All the sounds of the battle can be picked up by using a number of such instruments—one on board a destroyer, another with the director on a fast motorboat, a third on a submarine, and others on boats stationed wherever needed. For the early sequences, the larger sound receiving equipment is used on board the sailing ship. To set up and remove this valuable machinery requires the handling of about three tons dead weight, and formerly all sounds were filmed from this one position or from a generator barge towed out of the range of the cameras. Now the sound pick-up accompanies the director, and no boat is too small or too fast to carry it. Realism is thus added to sea pictures.

THE motion picture companies pay the owners of these old sailing ships from $500 to $2,000 each for them, while the cost of rebuilding and outfitting them for service in a sea picture ranges up to ten times this sum. In one recent sea film, the United States Government lent more than $55,000,000 worth of ships and equipment, including three submarines, seven destroyers, a mine-sweeper, and one or two tugs, all expenses of operation being paid by the picture company.

Interiors of submarines, destroyers, and sailing ships were built on the lot near Los Angeles, and there the interior sequences were made, as were all those sections in which women appeared. Thus the sending of a famous old windjammer to the bottom involves not only the cost of the vessel, but fifty to one hundred times that amount.

Stop Slamming Doors
EARN $15 Up to Daily!

Kant-Slam Door Check is an amazing new invention that closes all doors silently and automatically. Holds doors open when wanted open. Operates on new oil principle. Low priced. Everlasting. Easily installed in 10 minutes. Never needs attention.

A REAL DEMONSTRATOR Furnished Every Agent

You get orders quickly demonstrating actual sample on easy to carry miniature door. Every office, factory, store, institution and public building needs a Kant-Slam for every door. Rush name and address for details of amazing money making opportunity.

FREE Demonstrator to Workers

KANT-SLAM DOOR CHECK CO., Dept. T-10, Bloomfield, Ind.

This Book Has Helped Thousands to Success

The Real Estate Educator

The New Revised Edition, contains Questions and Answers; Brokers' License Law; Dictionary of Words and Phrases in Real Estate and Construction; How to Appraise Property; Law of Real Estate; How to Advertise Real Estate; Legal Forms; Commissions to Agents; "Don'ts" in Contracts, etc. 288 pages. Cloth. Postpaid $2.00.

The Popular Science Monthly

381 - 4th Ave. New York

BE A RAILWAY TRAFFIC INSPECTOR

Both Bus and Railway—Steady Pay

ACTIVE MEN—19 to 55 needed at once for positions in this fast-growing profession. Rapid pay advances after a few months' experience. S. B. T. I. men also become executives. Interesting, outdoor work. Travel or remain near home.

One man writes: "I received $150 per month salary and think it was very liberal for a beginner." Another man writes that since he started in three years ago, he has climbed several rungs in the ladder and has acquired an executive position.

We train men thoroughly in a few weeks' time by our home-study course, on completion of which we place them in positions starting at $120 to $150 per month up, plus expenses, or refund tuition. Thirteen years' experience and success explained in our free booklet. Do not delay making your start!

Standard Business Training Institute
Div. 301 Buffalo, N. Y.

AGENTS 500% PROFIT
GENUINE GOLD LEAF LETTERS

Guaranteed to never tarnish. Anyone can put them on stores or office windows. Enormous demand, large profits, Paul Clark says: smallest day $28.70. R. L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark Street, Chicago

Learn Photography at HOME

Make money taking pictures. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free book, *Opportunities in Modern Photography*, and full particulars.

AMERICAN SCHOOL OF PHOTOGRAPHY
Dept. 1361, 3601 Michigan Ave. Chicago, U. S. A.

New York Electrical School

Established 1902

Ask for free booklet

40 West 17th St., N. Y. C.

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make $5.00 to $15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
381 Fourth Ave. New York, N. Y.

HOW TO FIT NEW PISTON RINGS

(Continued from page 72)

The head may be anywhere from eleven thousandths to thirty-seven thousandths of an inch smaller than the cylinder diameter, depending on the make of car. Of course the clearance is in proportion to the size of the cylinder. A big piston needs more clearance than a small one."

"I can see why that should be, easy enough," Penny said. "How much is it going to cost me to have this motor fixed? Will I have to have a new cylinder block?"

"I SHOULD say not!" laughed Gus. "These cylinders aren't so bad. I think I can fix 'em by honing. Of course if they were 'way out and scored into the bargain, then it would pay to have them reground to a larger size. I can hone and put in oversize pistons and the motor will be as good as new. I'll make sure the pistons run true in the cylinders, too. That's where a lot of amateur auto mechanics go wrong. They don't realize, when they put in new pistons and rings, that there's a chance that the new pistons may not sit straight on the ends of the connecting rods. If they don't, and the piston tips either forward or backward the least bit, it'll bind, just as sure as you're born."

"What do you do when you find the piston isn't true?" Penny asked.

"First you check to see whether the piston pin hole is exactly at right angles to the axis of the piston. If it isn't, you may find that the error is just enough to offset the slight kink in the connecting rod itself, and putting the piston on the rod the other way to will make everything jake. If that fails the only cure is to try another piston or else to put a kink in the connecting rod that will make the piston square."

"How do you do that?" asked Penny.

"I bend 'em in a press," Gus explained. "If I didn't have any special tools, I'd do it with a husky hammer and some hardwood blocks. The thing you've got to make sure of is that you put the kink in the rod in such a way that it won't throw the whole piston off to one side. If you do it'll bind worse than ever. You'll know when you've done that because the big end of the connecting rod won't have any end play on the crank shaft. There always should be a little."

"GOOD night!" exclaimed Penny. "This business has more ramifications than the Punic Wars! What else it there?"

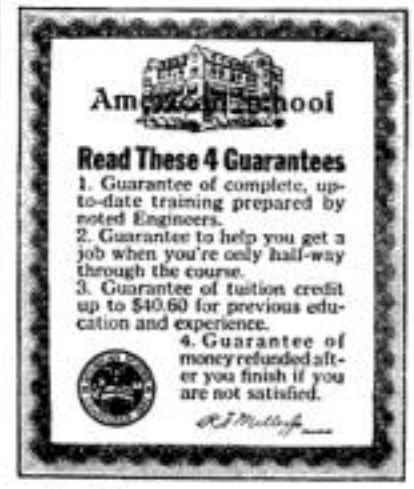
"Not so much," Gus grinned. "If the cylinders are round, if the rings fit the cylinder walls and the grooves in the pistons and there is no binding, you'll have things about right. Remember that when the rings get hot they expand and tend to close up the gap at the joints in 'em. The gap ought to be three thousandths of an inch for each inch of the cylinder diameter."

"I wonder," observed Penny, "if I'd have done better to install those spring inner rings instead of trying to put in new rings? They say they'll work even if the cylinders are worn quite a bit. Is that so?"

"No question about it," Gus agreed. "Steel spring inner rings will improve matters a lot when the piston rings lose their tension or are worn too much. They make an old motor act fine—for a while.

"After all," Gus concluded, "there's nothing can equal a real job that puts the cylinders and pistons and rings back into their original condition as near as possible. So, unless you're an expert, you'll do well to replace rings with new ones from the maker of your car."

MEN WHO ARE "HANDY" With Their Hands Make the Best DRAFTS-MEN



—and we'll back them with this EMPLOY-MENT CONTRACT

We are looking for more ambitious young fellows with factory, building-trade or any other kind of mechanical or office experience to prepare for and help place in well-paid Drafting positions. Such men, we find, are unusually successful as Draftsmen, because they know how things are done, and that's a priceless asset to the man who makes the blueprint plans. Get in touch with us and we'll tell you how you can cash in on your entire past experience.

Drafting Is Logically Your Next Move!

Of course you realize the biggest handicap to mechanical work is that you're limited in earning capacity to the output of your two hands, as long as you live. Even the skilled mechanic earning $40 to $50 a week has reached his limit. He can never earn more — when he gets old he will earn **less.** So we don't blame any man for wanting to get away from this futureless outlook. For wanting to get into something where he can use his **head** as well as his hands—where he will be paid for what he **knows,** instead of only for what he **does** . . . The Draftsman who makes plans is several jumps ahead of the workman who follows them. And so we want you to know that DRAFTING is a logical, natural PROMOTION from mechanical, building and office work—better-paid, more interesting—just the kind of work you'd enjoy doing.

SAVE UP TO $40.60

The way to a fine Drafting job for **you**—is easier than you think. It takes no "artistic talent" or advanced education. Thousands of men no smarter than you, with no more education or ability, have learned it quickly and you can, too. With the co-operation of some of the biggest employers and engineers in the U. S., we have worked out a plan to prepare you for Drafting work in your spare time at home—then to help you get a fine position *when you're only half way through the course.* Mail the coupon and we'll be glad to tell you all about this lifetime chance and the offer we are making right now to save you up to $40.60 in cash.

--AMERICAN SCHOOL--

Dept. D-148, Drexel Ave. & 58th St., Chicago

Please tell me, without cost or obligation, about your training and employment service in line marked X below and special money-saving offer.

☐ DRAFTING

☐ Architecture	☐ Law
☐ Contracting & Building	☐ Civil Engineering
☐ Electrical Engineering	☐ Auto Engineering
☐ Business Management	☐ Highway Engineering
☐ Accounting	☐ Mechanical Engineering
☐ Civil Service Positions	☐ High School (in 2 years)

Name.....

St. No. .....

City..... State.....

Age..... Occupation.....

90 Days the PRACTICAL WAY...then an ELECTRICAL JOB at Big Pay

Remarkable Tuition Offer for Short Time Only

Complete RADIO COURSE

Complete AUTOMOTIVE ELECTRICAL COURSE

Railroad Fare Paid to Cleveland

$40 to $100 a Week

MAIL COUPON TODAY For Big, Illustrated 48-Page **FREE BOOK**

Not a Correspondence Course—No Books—No Lessons

J. H. McSweeny, Pres.,
McSweeny Electrical Schools,
Dept. E-6-1, Cleveland, Ohio

Dear Mac: Without obligation, send me a copy of your big book on ELECTRICITY, also details of *Special Limited Tuition Offer.*

Name.....

Address.....

Town..... State.....

McSWEENY ELECTRICAL SCHOOLS

E-6-1, CLEVELAND, OHIO

MAIL FOR FREE INFORMATION

BEDFORD YMCA TRADE SCHOOL

1115 Bedford Ave., Dept. PS-1
Brooklyn, N.Y.

Send me without obligation complete information on (check subjects).

- ☐ Caterpillar Tractor Mechanic
- ☐ Aviation Mechanic
- ☐ Flying
- ☐ Welding
- ☐ Auto Mechanic
- ☐ Radio Mechanic and Television
- ☐ Electrical

Name .....

Street & No.....

Town.....State.....

AGENTS $6 A DAY

Wonderful chance to make $6 a day taking orders for Jiffy Glass Cleaner—the amazing new liquid that cleans glass without water, soap or chamois. Instantly removes grease and dirt without streaking. One application makes windows shine like crystal—and stay clean twice as long. Unequaled for windshields, mirrors, show cases, etc. Every housewife, motorist, storekeeper a prospect. Big profits. Steady repeat orders. This is only one of our 350 fast-selling profitable articles in big demand everywhere. Wonderful chance to make $6 to $12 a day—full time or spare time. Ford Tudor Sedan offered FREE to producers as extra reward. Write today for our superior money-making plan.

ZANOL PRODUCTS CO.

45 Monmouth Ave. Cincinnati, Ohio

LAW STUDY AT HOME

Become a lawyer. Legally trained men win high positions and big success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Earn

$5,000 to $10,000 Annually

We guide you step by step. You can train at home during spare time. Degree of LL.B. conferred. LaSalle students found among practicing attorneys of every state. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 64-page "Law Guide" and "Evidence" books FREE. Send for them NOW.

LaSalle Extension University, Dept. 183-L Chicago

The World's Largest Business Training Institution

"Heaven and Hell"

With a sketch of Swedenborg's life

The most interesting of the **profound writings of SWEDENBORG** the renowned theologian, philosopher and scientist. 632 page book treating of the Life after Death, sent without further cost or obligation on receipt of **5c**

Write for complete list of publications

SWEDENBORG FOUNDATION INC.

Room 1216 18 East 41st St., New York

TRI-STATE COLLEGE

DEGREE IN 2 YEARS

B.S. DEGREE in Civil, Electrical, Mechanical, Chemical, Aeronautical Engineering in 2 years. Those who lack high school may make up work. Living costs, tuition low.

Catalog 512 College Ave., Angola, Ind.

SALES WORKERS

With mechanical inclination, to place Air-Lec Door Operators for garages and industrial plants; should have car; a short training and demonstration will be given you in your territory good commissions begin immediately. Write

SCHOELKOPF MFG. CO.

Madison Wisconsin

Denison's plays

56 Years of Hits

We supply all entertainment needs for dramatic clubs, schools, lodges, etc., and for every occasion.

Songs, Minstrels, Musical Comedies, Operettas, Vaudeville Acts, Blackface Skits

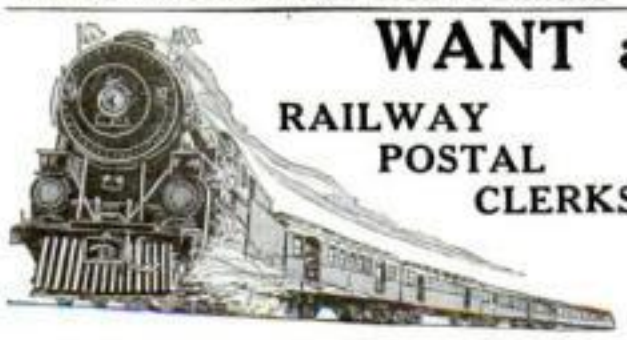
Catalogue Free

T. S. Denison & Co., 623 S. Wabash, Dept. 26 Chicago

All This for Only 15 Cents

Send only 15c RIGHT NOW and receive The Pathfinder every week by mail for the next 13 consecutive weeks. In these 13 issues you will get 426 pages, with 300 pictures, 900 unusually interesting articles on people and things you want to know about, 1800 picked news items from everywhere, 2500 jokes, squibs and cracks, stories, etc. Newsiest, snappiest, most entertaining paper in the whole world. The biggest 15c worth YOU ever saw. Send now. Address **Pathfinder, Dept. 76, Washington, D.C.**

WANT a Government Job?



RAILWAY POSTAL CLERKS

$158 to $225 Month

Mail Coupon Before You Lose It

FRANKLIN INSTITUTE, Dept. K265
Rochester, N. Y.

Sirs: Rush to me without charge copy of 32-page book, "How to Get U. S. Government Jobs," list of positions open to men—women 18 to 50 and full particulars telling how to get them.

Name.....

Address.....

City Carriers—Postoffice Clerks—General Clerks
Inspectors of Customs—Immigrant Inspectors
Steady Work—No Layoffs—Paid Vacations

SCIENTIFIC TREASURE FOUND IN BADLANDS

(Continued from page 23)

set, the specimen is undercut, turned over, and the process repeated. Not until bones and the earth or stone with which they are surrounded are completely incased in their plaster and burlap covering are they removed from the spot where they were found. Then they are boxed for shipment to the expedition's mother institution.

A fossil hunter's troubles are by no means over once he gets his specimens safely into his museum. The digging, in Brown's words, is the easiest part of the job. On his nine dinosaurs, a small army of preparators will be at work for several months to come.

The preparators take up the work where the field party left off. Behind the scenes in the museums the specimens are opened and the material surrounding the bones is carefully removed. At the Smithsonian, I saw one man at work, with a pick the size of a shoemaker's awl, on a section of a whale's backbone about three feet long. Yet the entire specimen that this man would have to uncover was perhaps thirty feet in length. Dr. Gilmore told me that the little rhinoceros he had found would require about a year's steady labor before it could be set up with its skeleton cleaned and arranged just as it had been in life.

We went out into the exhibition hall, where Dr. Gilmore paused before the massive skeleton of the giant *Diplodocus* which dominates that big room. With seventy-odd feet of over-all length, it towers up from the floor more than sixteen feet. "That skeleton," said the scientist, "represents as it stands just nine years of one man's working time."

My eye ran along the immense length of backbone and was lost in its complicated articulations, with the complexity of framing spreading out from it like the barrel of a locomotive boiler. Dr. Gilmore explained that much of the work of erecting this monster was not visible to the eye of the casual observer. There was, for instance, two weeks of careful blacksmith work on the concealed bracing of each of its four legs.

Naturally no one knew at first how these prehistoric beasts looked when alive. Only bits of bones were found, and no effort was made to put them together in their natural order. Fifty years ago the first restoration of an extinct animal was attempted. After years of work this monster began to take form. Later, when complete skeletons were unearthed, fossil students were able to check their earlier work and correct mistakes.

There is nothing in the world now to serve as a living model for these restorations and they can be made only after the most painstaking study and observation. Indeed, the problem of putting these ancient bones together is much the same as that which would confront anyone who tried to assemble the separate parts of a motor car without ever having seen one.

A GIFT THAT COMES 12 TIMES A YEAR

Send Popular Science Monthly—an all year 'round reminder of your thoughtfulness. For special rates on gift subscriptions see page seven

Copyrighted material

WHY EMOTIONS RULE OUR LIVES

(Continued from page 44)

conscious experience of bodily change, then it must follow that different emotions are the experience of different bodily changes. I believe the trouble is that there are physical changes, some of them chemical perhaps, which so far have escaped measurement or even detection. After all, the physical reaction in the case, say, of anger, is a reaction of the organism as a whole. Muscles, skin, blood, nerves, glands, all play their own subtle parts in this change. Even with the most careful measurements, it seems quite possible to miss some of the component parts in such a complex picture.

MR. MOK: Are there no other ways of checking up on this relationship between the emotions and bodily changes?

DR. POFFENBERGER: Yes, there are. The most recent attempt to measure these physical reactions is by means of the so-called psychogalvanic reflex, which really is the electrical resistance of the skin. This electrical resistance, it is found, is greatly lowered by emotions of almost any kind. The person being tested dips one finger in each of two separate jars containing salt solution and connected to the electrical apparatus. A small electrical current then is passed through the two fingers from one jar to the other. The resistance of these two fingers is measured by the electrical apparatus, which is essentially a standard Wheatstone bridge. If the subject is excited or afraid or experiences any other emotion, this skin resistance is likely to decrease a good deal. Occasionally, this test is used as a so-called "lie-detector," but it has been proved ineffective for that purpose.

MR. MOK: What of the relationship between the emotions and the glands of internal secretion?

DR. POFFENBERGER: As Dr. Ruckes told you last month (P.S.M., Dec. '31, p. 133), little is definitely known about it, though such a connection undoubtedly exists. Dr. Cannon has established it in the case of adrenalin (the secretion of the adrenal glands) and anger in cats and dogs. In a series of interesting experiments, he has shown that there is an actual increase of adrenalin in the blood under stress of anger. These tests are extremely difficult, and the truth of the matter is hard to get at, because, as Dr. Ruckes has also told you, the glands of internal secretion are chemically interbalanced.

MR. MOK: What did Dr. Cannon do?

DR. POFFENBERGER: He fastened a cat to a laboratory table. The animal had just eaten, and careful measurements and even X-ray pictures were made of the movements of its stomach. Its blood pressure was taken, its heartbeat and breathing timed, and so forth. The cat was perfectly normal and calm. Now a dog was brought into the laboratory. The dog barked and snarled at the defenseless cat. Naturally, the cat got furious. Immediately, a new set of measurements were made. It was found that the digestive contractions of the stomach had stopped at once. Changes had taken place in the circulation and the blood pressure had increased in such a way as to place the animal in the most favorable position for attack. Next day, the experiment was repeated. Again, the cat was fed and fastened to the table, and all the measurements were taken. But this time, no dog was brought into the laboratory. Instead, a quantity of adrenalin was injected into the cat. The results were virtually the same.

MR. MOK: This seems to bear out James's theory. The cat got angry, or at least showed the symptoms of anger, because there was an increase of adrenalin in its blood.

DR. POFFENBERGER: Exactly. One attractive interpretation of these physical responses in emotion is that they have developed, in the course of evolution, because of their usefulness as means of protection. Thus anger responses put the animal in the best position for attack, and fear responses in the best position for defense. In extreme fear, the response takes the form of paralysis. This is most striking in the case of the opossum, a small, weak animal, which is rendered completely motionless by fright, and through this lack of movement escapes attention, or if detected and thought dead by its enemies, is not molested. Now, as I said before, we still have several of these emotional responses in vestigial form. But instead of being useful, they now are harmful to us. For example, the temporary paralysis that may seize a person in front of an oncoming street car or automobile may have been of some service in primitive times, but now it is a distinct danger. Very likely, we also are handicapped rather than helped by our anger responses, which stood us in good stead in the caveman days. Surely, in civilized society, it usually is better to hide than to show anger. Some day we may get rid of these reactions. But dropping such appendages is a slow business. As I said when we were talking of the love response, it probably won't happen in the next million years.

MR. MOK: You have told me about the primitive emotions—fear, anger, and love. How about all our other feelings?

DR. POFFENBERGER: Picture these three primary emotions as a foundation. On top of that, there is built up, by means of memories, imagination, and association, a complex structure called the sentiments. These more nearly represent the experience of the average civilized person than do the emotions. Take, for instance, the sentiment of love. It is pretty far removed from the primary emotion.

MR. MOK: There is one point I would like you to clear up. Is the primary emotion of love the same thing as the sex impulse?

DR. POFFENBERGER: No, the primary emotion of love is that out of which both the sex impulse and the sentiment of love develop. It is the primitive experience of pleasure which Dr. Watson found was produced in newborn infants by stroking the skin.

MR. MOK: Isn't hate a primary emotion?

DR. POFFENBERGER: No, hate is a sentiment. It is a mixture of the emotion of anger, memories of wrongs done, imaginings of wrongs that never were done, and anticipation of wrongs that may be done.

MR. MOK: What of joy and grief, weeping and laughing?

DR. POFFENBERGER: In this talk, I have tried to give you a picture of the primary emotions that form the basis of our emotional life. But a civilized adult cannot express these emotions as he wishes. Conventions, social customs, laws, education, all take a hand in restraining them, directing them into certain channels, and molding our behavior in a more or less definite way. Let us discuss those matters another time.

HOW do you use your brain? What is a moron? What is a genius? Can anything be more fascinating than a study of the mental differences between people? The next installment of this great series will tell you why some men are bullies and some meek as Moses, and will give you the very latest discoveries about human behavior. In February POPULAR SCIENCE MONTHLY, *on sale December 31.*

BIG OPPORTUNITIES in AVIATION

AVIATION is growing rapidly. During the past year transport operators increased their activities over 200%. 3,007,670 people traveled by air. The total length of air mail lines in the United States is now 29,589 miles. Every 24 hours 84,771 miles are flown.

The growth of Aviation offers great opportunities and big pay to aviation mechanics. You can train for a good position at one of the Curtiss-Wright Aeronautical Training Schools—leading Aviation Schools in the United States. A new Mechanics' Course provides the best preparation for a career in Aviation that you can possibly find. The sound, practical experience you obtain in this Course applies towards a United States Department of Commerce airplane and engine mechanic's license.

Train to be an aviation mechanic. No other industry offers a brighter future, more interesting work, or better pay.

Curtiss-Wright Aeronautical Training Schools are located at New York, Chicago, Los Angeles, Baltimore, Boston, Pittsburgh, and 25 other leading cities. If you are looking for a real opportunity and a chance to make big money, mail this coupon for complete details about the Curtiss-Wright School near your home.

CURTISS-WRIGHT AERONAUTICAL TRAINING SCHOOL

29 WEST 57th STREET
NEW YORK CITY

Curtiss-Wright Aeronautical Training School
29 West 57th Street, New York City

Please send me complete details about your new Aviation Mechanics' Course.

Name.....

Address.....

City.....*State*.....

Age.....

Copyrighted material

Come West at Our Expense!

For a limited time we are making a railroad fare offer from any point in the United States to Los Angeles. Just think of it! A trip to California with your railroad fare allowed.

Quickly Train for Big Pay Jobs

Quickly train for Big Pay Jobs in Electricity. Unlimited Lifetime Employment Service. Employers insist on our men instead of green, half-baked electricians who don't know what it's all about. You need good training to earn Big Pay!

Don't Worry About Money! We'll Help You!

If you are short of money, we'll help you. We help you secure a part time job to earn living expenses while learning.

It's Easy at National!

Short, condensed training in our Million Dollar Practical "School of Shops" . . . instruction on the most modern equipment money can buy . . . with the country's best staff of expert, experienced instructors. No previous experience needed. None too old or too young to learn. Start any time. WRITE TODAY! We'll send you the full story about Railroad Fare Offer, Unlimited Employment Service, etc. New Book sent FREE.

FREE BOOK

NATIONAL ELECTRICAL SCHOOL

Dept. 17-D, 4006 So. Figueroa St., Los Angeles, California

LEARN ORNAMENTAL COLORED CONCRETE TRADE

Now—you can learn how to make one-piece cement Fireplaces in any color, effect or design! Learn how to make both cement and plaster molds—art plaques. Reproduce pictures, designs, scrolls, coat-of-arms, etc. in your own molds. Produce with cement—marbles, tiles, granites, grained wood, Travertines, bricks, terrazo, sand-stone, and two-tone effects. Learn how to make hearths, posts or porch caps, colored flag-stones, garden benches, table tops, portable building blocks, etc. There's pleasure and profit in this work—and you can do it all without the use of any machinery whatsoever!

ORNAMENTAL CONCRETE INSTITUTE

246 Fifth Avenue, New York, N. Y.

HERE'S YOUR GUIDE TO AVIATION SUCCESS!

"Skyward Ho!" gives full information on training at **World's Largest Commercial Flying School.** Check the course you prefer—mail with your *name, address* and *age*. We'll send the book.

- ☐ *Executive* Transport Pilots' Course, 19 months.
- ☐ Transport Pilots' Course, 8 months.
- ☐ Limited Commercial Pilots' Course, 13 weeks.
- ☐ Aeroplane & Engine Master Mechanics' Flight Course, 48 weeks.
- ☐ Aeroplane & Engine Mechanics' Course, 30 weeks.

PARKS AIR COLLEGE

Section 1-PS EAST ST. LOUIS, ILL.

PATENTS

Trade Marks, Copyrights, Patent Litigation Handbook with illustrations, 100 mechanical movements. *Send free on request.*

ALBERT E. DIETERICH

Successor to Fred G. Dieterich & Co.

formerly member Examining Corps U. S. Patent Office

REGISTERED

PATENT LAWYER and SOLICITOR

681-A Ouray Building

30 Years' Experience Washington, D. C.

SPIDER WEBS CATCH CRIMINALS

(Continued from page 36)

The following day, a scientific detective, poking among the charred ruins of the burned dwelling, unearthed a bit of fused glass. His knowledge of physics instantly told him that the temperature produced by the burning material of the house could never have fused glass of that kind. He checked up on the weather reports.

Showers, accompanied by lightning, he found, had swept over the region just prior to the fire. A thunderbolt undoubtedly had crashed into the isolated dwelling, its tremendous heat fusing the glass as it ignited the structure. This evidence, supplied by a single clue in the hands of a scientifically-trained sleuth, solved a mystery which otherwise might have jailed an innocent man.

IN INNUMERABLE other ways, a knowledge of physics aids in the battle with crime. Run over the products of research in the realm of physical science—the radio, the teletype, the ultra-violet and X-ray, the latest cameras and the airplane, to name but a few examples of an almost endless list. They are giving invaluable assistance to officers of the law. Radio-equipped police cars make split-second arrests; descriptions of wanted men flash from one end of the country to the other; special photographic squads race in fast machines to the scene of a crime, shooting pictures from every angle to aid the sleuth. In the not distant future, Inspector Joseph Donovan, head of the Bureau of Criminal Identification, in New York City, recently predicted, photographs of wanted men will flash on television screens in the homes of citizens as an aid to capturing crooks.

An innovation in the use of motion pictures in police work is reported from Germany. Here the cameras record the bodily deformities caused by different occupations. These reels are used in training detectives to recognize men of various professions by noting peculiarities in their gait and posture.

One of the cleverest bits of science-using crime detection in police history recently ran down a venomous writer of blackmail letters in San Francisco, Calif., through the use of invisible ultra-violet rays.

"Playing a hunch," a scientific sleuth sent thirty two-cent stamps to a man he suspected of the crime with an unsigned note saying they were being forwarded as "conscience money" by a clerk who had short-changed him. Before being sent, each stamp was carefully marked with invisible lines of aspirin dissolved in water. Under ultra-violet light aspirin fluoresces in glowing purple. A week passed by. Then the intended victim of the blackmail plot received a "final" threat. The detective hurried to his home, obtained the envelope, and in his laboratory slipped it under the ray apparatus and switched on the "black light." His eyes shone with pleasure. Crisscrossing the stamp were the fine lines of purple fire that spelled conviction for the extortioner.

ANOTHER application of rays, which may prove highly important to the scientific detective, has just been announced by a Washington, D. C., physician, Dr. Thomas A. Poole. In making more than 2,000 X-ray pictures of the nasal sinus cavities, located in the bones of the skull near the nose, he discovered that those of no two individuals are identical. And as the cavities keep the same shape throughout life, X-ray pictures of them are always the same. Tissue decays soon after death, but bone does not. Thus bodies dug up years after a murder may be identified by X-raying the skulls, Dr. Poole declares. The Washington police, as well as representatives of several insurance companies, have studied the new identification method and are reported to be very enthusiastic over it.

Medical men and medical knowledge are frequently of assistance to the baffled detective. One master ferret of the law, whose medical background played a deciding part in a number of cases, told me that, from a single piece of human skeleton, an expert examiner can often determine the height, weight and approximate age of the victim of a murderer.

THE most extraordinary instance of a fragment of bone betraying a slayer occurred in the middle west about four years ago.

Late at night, a black sedan slid noiselessly up the side street of a middle-western city and stopped in the shadow of a large leather-goods factory. Fifteen minutes later, in the lurid bluish light of a blowtorch, a pair of cracksmen were working swiftly over the big office safe, the night watchman bound and gagged in a corner. The torch had eaten its way almost through the steel door when one of the crooks jumped to his feet with a cry. The watchman, struggling to an upright position, had edged along the wall to the burglar alarm. Both thugs fired at the same instant. One bullet crashed through the watchman's neck and spine, burying itself in the wall behind him. He crumpled to the floor, dead. The other bullet went wild.

But the shots had come too late. The alarm siren was screeching in the night when the burglars leaped into the waiting car. And a police machine, going nearly a mile a minute, followed in close pursuit as they raced for the open country. Six miles from town, the black sedan swerved into a side-road, slid to a stop, and the two thugs jumped to the ground, firing back as they ran for a near-by wood. At the edge of the road, one of the men stumbled and fell, his leg shattered by an officer's bullet. The other made good his escape.

AT THE trial of the captured outlaw, his attorney maintained that *his* bullet had gone wild while the lead from the gun of his escaped pal had caused the watchman's death. The state called in a scientific detective. He examined the bullets dug from the office wall, compared the markings on them with those left on test bullets fired through the revolver of the captured gangster.

When he had determined which bullet had come from his gun, he studied the battered lead at its nose under a powerful magnifying glass. Half buried in the metal, he saw a speck of something white. At first, he thought it was a bit of plaster from the wall. Then he picked it free and placed a minute cross-section under his compound microscope.

Peering through the lens, he saw, by the cellular construction of the piece, that it was bone. The bullet, in its course, had carried with it a fragment of shattered vertebra and this strange, silent bit of evidence convicted the slayer.

Still another phase of scientific learning provides clues for a master sleuth. This is the study of various animals and their habits. Not long ago, an insane killer in New York City fastened two heavy horseshoes to a baseball bat. His fiendish scheme was to strike a fatal blow which would suggest that death had come to the victim from the kick of a horse.

The detective in charge of the case, from his knowledge of animals, saw that the position of the victim's body and the location of the blow would *(Continued on page 121)*

SPIDER WEBS CATCH CLEVER CRIMINALS

(Continued from page 120)

have been different if a horse had actually caused the fatality and he began his hunt for clues which eventually led to the capture of the maniac.

MINUTE, almost invisible forms of life, as well as larger animals, sometimes play dramatic parts in assisting the sleuth to get his man. Entomology, the study of insects, is a science often turned to by master detectives. I was told of one case in which a suspect's alibi was broken down by expert testimony on the length of time fleas can live in water and another case which hinged on how many days elapse after death before certain insects attack a body. But the strangest and most thrilling instance of a scientific sleuth unraveling a crime through the aid of insects was the weird "Spider Web Murder Case," reported on the Pacific Coast.

Two or three miles from the outskirts of a California city, a long-deserted farmhouse was falling into ruins. Locally, it was known as "the haunted house." Vines clambered over its tumbledown chimney and its dust-covered panes were festooned with ancient cobwebs. One fall evening, shortly after dusk, two farmers were passing the eerie spot when they heard a woman's stifled scream coming from the old house. They halted, straining their ears. The cry was not repeated. They were on the point of going on, thinking their imaginations had deceived them, when there came the hollow slam of a back door and the sound of stealthy, rapidly-retreating steps.

WITHOUT waiting longer, the men approached the deserted dwelling. Using a small flashlight, they cautiously peered through a window into the dark, cobwebby interior. On the floor, directly under the window, they were horrified to see the body of a murdered woman, the belt of her coat knotted tightly about her throat.

As soon as police were able to identify the body, plainclothesmen began tracing the recent movements of all the dead woman's friends. In the home of one of them, they discovered a suit of clothes with gauzy spider's threads caught in an overlooked crease. The man explained that the previous week he had been driving in the country when his radiator began to steam and he had crossed a field to get water from a brook to fill it. As he got in the car, he said, he noticed his clothes had picked up a number of spider's webs from the bushes and weeds of the field.

This story seemed plausible enough. But the scientific detective, handling the case, took no chance. He carried the precious gauze-like threads to an expert entomologist. When this scientist straightened up from his microscope he declared there could be no mistake: the fragments had come from a web spun by a species of spiders which live only in houses and are never found in fields! This sensational twist to the case broke the nerve of the suspect and he confessed to his brutal crime.

It is by such dramatic applications of specialized knowledge that the scientific sleuth of today outwits the craftiest crook, writing brilliant new pages into the record of modern crime detection.

WATCH for the next installment of this sensational series. Learn how firearms experts convict murderers through microscopic scratches on lead and brass. Thrilling stories of master sleuths. Don't miss this dramatic chapter in the story of science's battle with the underworld. Order your February copy in advance. On newsstands December 31.

PATENTS
INVENTORS

Write for these FREE BOOKS!

At the left is a view of my drafting and specification offices where a large staff of experienced experts is in my constant employ. All drawings and specifications are prepared in my offices.

Protect Your Ideas
Take the First Step Today

If you have a useful, practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea (even though the inventors may live in different sections of the country and be entirely unknown to one another). In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

Prompt, Careful, Efficient Service

This large, experienced organization devotes its entire time and attention to patent and trademark cases. Our offices are directly across the street from the U. S. Patent Office. We understand the technicalities of patent law. We know the rules and requirements of the Patent Office. We can proceed in the quickest, safest and best ways in preparing an application for a patent covering your idea. Our success has been built on the strength of careful, efficient, satisfactory service to inventors and trademark owners located in every state in the Union.

Strict Secrecy Preserved—Write Me in Confidence

All communications, sketches, drawings, etc., are held in strictest confidence in strong, steel, fireproof files, which are accessible only to authorized members of my staff. Feel free to write me fully and frankly. It is probable that I can help you. Highest references. But FIRST—clip the coupon and get my free book. Do THAT right now.

No Charge for Information on How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will also send you my "Record of Invention" form, on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon and I will send you the booklet and the "Record of Invention" form, together with detailed information on how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

Clarence A. O'Brien
Registered Patent Attorney and Attorney-at-Law
Member of the Bar of The Supreme Court of the United States, U. S. Court of Customs and Patent Appeals, U. S. Court of Claims, Court of Appeals, District of Columbia and Supreme Court of the District of Columbia.
Practice confined exclusively to Patents, Trademarks, and Copyrights

Mail this Coupon Now

Clarence A. O'Brien
Registered Patent Attorney
88-C Security Savings and Comm'l Bank Bldg., Wash., D. C.
—or—
Suite 1106, Dept. B-13 Woolworth Bldg., New York City

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" form without any cost or obligation on my part.

Name.....

Address.....

.....

(Important: Print or Write name clearly)

Copyrighted material

IF YOUR WIFE should put her heart on paper, is *this* what she'd say to you? And is it *your* fault? Listen, man: isn't this a fact, the reason you haven't ever gotten anywhere is because you lack *training?* It's not too late, you can get training! Every year thousands of men, all ages, turn to International Correspondence Schools to acquire the knowledge they need. So can you! Mark and mail the coupon today!

INTERNATIONAL CORRESPONDENCE SCHOOLS

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7603-G, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the subject *before* which I have marked X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect	☐ Bridge Engineer
☐ Architectural Draftsman	☐ Automobile Work
☐ Building Estimating	☐ Plumbing ☐ Steam Fitting
☐ Wood Millworking	☐ Heating ☐ Ventilation
☐ Concrete Builder	☐ Sanitary Engineer
☐ Contractor and Builder	☐ Sheet Metal Worker
☐ Structural Draftsman	☐ Steam Engineer
☐ Structural Engineer	☐ Marine Engineer
☐ Electrical Engineer	☐ Refrigeration
☐ Electric Wiring	☐ R. R. Locomotives
☐ Electric Lighting	☐ Air Brakes
☐ Welding, Electric and Gas	☐ Train Operation
☐ Telegraph Engineer	☐ R. R. Section Foreman
☐ Telephone Work	☐ R. R. Bridge and Building Foreman
☐ Mechanical Engineer	☐ Chemistry ☐ Pharmacy
☐ Mechanical Draftsman	☐ Coal Mining Engineer
☐ Patternmaker ☐ Machinist	☐ Navigation
☐ Reading Shop Blueprints	☐ Agriculture
☐ Civil Engineer	☐ Textile Overseer or Supt.
☐ Highway Engineering	☐ Cotton Manufacturing
☐ Surveying and Mapping	☐ Woolen Manufacturing
☐ Gas Engines ☐ Toolmaker	☐ Fruit Growing ☐ Radio
☐ Diesel Engines	☐ Poultry Farming
☐ Aviation Engines	

BUSINESS TRAINING COURSES

☐ Business Management	☐ Business Correspondence
☐ Industrial Management	☐ Lettering Show Cards
☐ Personnel Management	☐ Stenography and Typing
☐ Traffic Management	☐ Complete Commercial
☐ Accountancy	☐ English ☐ Signs
☐ Cost Accountant	☐ Civil Service
☐ C. P. Accountant	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Mail Carrier
☐ Secretarial Work	☐ Grade School Subjects
☐ Spanish ☐ French	☐ High School Subjects
☐ Salesmanship	☐ Illustrating ☐ Cartooning
☐ Advertising	☐ Lumber Dealer

Name..... Age.....

Street Address.....

City..... State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

How To Secure A Government Position

Why worry about strikes, layoffs, hard-times? Get a Government job! Increased salaries, steady work, travel, good pay. Open to citizens 18 to 50. I'll help you become a Custom House Clerk, Railway Postal Clerk, Post Office Clerk, City Mail Carrier, Rural Carrier—or get into any other Government job you want. I was a Secretary Examiner of Civil Service Commission for 8 years. Have helped thousands. Get ready NOW for the NEXT *Railway Postal Clerk Examination.*

NOW FREE My 32-page book tells about the jobs open—and how I can help you get one. Send the coupon for your copy TODAY.

A. R. PATTERSON, Civil Service Expert,
PATTERSON SCHOOL, 161 Wisner Bldg., Rochester, N. Y.

Please send me, without obligation, your free book, "How to Secure a Government Position."

Name .....

Address .....

WHAT PUPILS TAUGHT ME

(Continued from page 31)

I explain how the pull of the propeller in level flight is, say, 1,000 pounds, and the pull of gravity when the plane is plunging in a vertical dive, say, 4,000 pounds. The correct gliding angle to give the plane the same forward speed as provided by the revolving propeller would be approximately one quarter of a right angle downward.

In explaining how to recognize an approaching stall, I have found the most easily understood definition of the sensation is "a feeling like walking on thin ice that may break through any instant." In analyzing the different sensations and actions of flying in this way to help students, I have also helped myself, clearing up points in my own mind.

On their first cross-country flights, most students naturally want to fly over their homes and give their folks a thrill. Frequently they want to land in some field near by. As a result, I have brought ships down in baseball fields, tennis courts, farmyards, cow pastures, and abandoned subdivisions. It has given me practice I should otherwise have missed. Whenever possible, I sit down in a plowed field or one that has been burned over or recently cut. A field covered with hay or long grass is a dangerous proposition. Nobody knows what obstacles may be hidden in it.

I HAD one thrilling experience with such a field six or seven years ago. I had taken off with a Broadway actor in a Curtiss "Jenny" with an OX motor. At 100 feet, the engine spit, backfired, stopped dead. We were too low to turn and had to land straight ahead where the ground had been laid out as a subdivision and later abandoned to long grass and weeds. It looked level enough, but I couldn't see beneath the tangle of vegetation. I skimmed low over the tall grass, pulled up the nose of the Jenny and pancaked into the tangle. We rolled a score of feet and stopped with a bump. When we scrambled down, we saw the right wheel was jammed against a boulder two feet in diameter. That boulder had stopped us only a few feet from the brink of a hole seven feet deep and big enough to bury the whole plane! It was an excavation dug for a house that was never built. Such narrow squeaks, while instructing students, have taught me to land only where I can see the ground; or, if I have to come down in weeds, always to pancake.

Another valuable kind of practice I got from instructing has been in judging distances accurately. A trained pilot brings his ship down as far as possible from fences and trees, but an inexperienced beginner sometimes overshoots and lands heading straight for a tree or boundary fence. Then it is up to the instructor to avoid a crash. Hundreds of such landings have taught me just how far I can go and still stop a ship in time.

ONE student gave me more practice in these hair-raising split-second landings than any other. His nickname, "Santa Claus," grew out of one of the most thrilling landings I ever saw a rookie make. He was up on his first solo. Coming into Curtiss Field from the north, he undershot the runway. His Fledgling made the approach too low to clear the fifty-foot trees near the old power station. The orange-colored biplane disappeared for an instant behind the branches. The ambulance driver and fire-truck operator leaped to their wheels, ready for a bad crash.

Then the ship burst into view. Cutting cleanly through the tops of two trees, it slid down to the field, twigs and leaves and branches fluttering from the landing gear and bracing wires. One eight-foot forked branch had wedged around the leading edge of a lower wing, its twigs flapping and pounding the canvas. The ship looked like a Christmas tree when it sat down at the edge of the field. Afterward the other students called the pilot "Santa Claus."

Although he later became a skillful flyer, he took longer to learn to land than any other student I ever had. After he scalped the oak trees, he went to the other extreme, overshooting and coming in so high his momentum carried him dangerously near the fence on the far side of the field. To cultivate his judgment of distances, so he could tell in advance when he was landing too near obstacles, I had to let him go until the last moment, then grab the controls and "put on the air brakes" to stop the plane in time.

THERE are two kinds of air brakes a pilot can use to slow down a ship that comes in for a landing at too high speed. These are the "side-slip" and the "fishtail." In side-slipping, the rudder is kicked over, swinging the machine around so it progresses sidewise along its original path. The sudden added resistance offered by the side of the fuselage rapidly slows down the machine. In fishtailing, the rudder is alternately kicked right and left while the wings are held level. This swings the rear of the plane from side to side like the movements of the tail of a fish, adding to the resistance and cutting down forward speed.

For nearly a week, I worked with Santa Claus before he could put the Fledgling down in the center of the field. Once we rolled within twenty feet of the trees and on another occasion came even closer to the far boundary fence. When this practice was over, I felt I could land on a cracker.

It wasn't long before I was thankful for it. On a cross-country flight with an advanced student, it squeezed me out of a tight corner. East of Hicksville, Long Island, the water line to our OX engine broke in mid-air. The water poured from the radiator and the overheated motor cut out at 800 feet.

I rocked the stick from side to side and slapped my helmet with my left hand, signaling the student to release the controls. Only one spot big enough for a landing was within reach. It was a little patch about 200 feet long. A farmer's house, high barn, and silo bordered one side, high trees the other. At one end there was a deep ditch, and swampy ground stretched away at the other. More than that, the field, instead of being flat, was dome-shaped, sloping up to a high point in the middle!

IF WE landed on top of that knoll, we would roll too far and pile up in the swamp. If we landed on the upslope, a miscalculation of a few feet would either wreck the plane by hitting the ditch or wash out the landing gear by striking the hillside at a steep angle.

Kicking the ship over into a fast half-circle, I headed for the field in a violent side-slip. I was still fishtailing when the ditch swept under us. Just as the wheels touched, I straightened out and pulled up the nose. We bumped along the upslope for less than sixty feet and came to a stop right on the top of the knoll. As I climbed out, I mentally thanked Santa Claus and the other students who had given me weeks of "air brake" practice and made that landing possible.

Long ago, when I started flying, an old-timer said to me: "The best pilot is the one prepared for the most emergencies." Consequently, the unexpected, lightning-quick crises of the training cockpit make an instructor a better pilot by preparing him for the unexpected.

HE FLEW BEFORE THE WRIGHTS WERE BORN

(Continued from page 18)

cited as one of his great contributions to the development of the dirigible. Young Zeppelin, then a twenty-four-year-old Prussian lieutenant attached as an observer to the Northern army, was in this country at the time. His first airship was not built until 1900. Did he witness the experimental flights of the American pioneer? Did he have an opportunity to examine his mechanism? Did he notice the divided gas bag? In any case, the idea originated with Dr. Andrews, who patented it in July, 1864.

Twelve hundred yards of Irish linen were bought for the cylinders and 1,300 yards of cambric muslin for the gas containers. John Wise, the balloonist, was engaged to varnish this material and to make it up. He finished the containers, but declined to make the cylinders. This Dr. Andrews did himself with a varnishing machine of his own invention. The sections were sewn together by women of Perth Amboy, some of whom still survive and vividly remember the episode.

THE capacity of the balloon was 26,000 cubic feet. As there was no local supply of manufactured gas, she was filled with hydrogen. The machine was completed and made her first flights in June, 1863.

Until that time, Dr. Andrews, who now was fifty-seven years old, had never been in a balloon of any kind. His knowledge was purely theoretical, and as there was no one to teach him, he could learn to fly his ship only by getting into it and flying it. Considering that the sides of the basket reached no higher than his knees, this called for superb courage in a man of his age.

In the first trial, the gas containers collapsed. As other details, too, needed attention, the ship was deflated and did not fly again until July. This time, the gas containers were taken out and the cylinders inflated directly, which lightened the ship by 180 pounds and improved her performance. With further changes in frame and rig, she was flown again in August.

Dr. Andrews was acquiring a measure of pilot's technique. He realized that the aereon was too sensitive, too quick in responding to the controls to be entrusted even to the experienced balloonists of the army, who, of course, were entirely untrained in dirigible practice. He found, for example, that he could change the angle without moving the weighted car; shifting his own weight was sufficient to disturb the balance. These features, as we now understand them, would have been virtues under different circumstances. A real defect, however, was that the ship was so quick in obeying the rudder that an intended turn might develop into a complete circle before she could be checked.

ANXIOUS to make decisive tests of her maximum speed and her behavior at a high altitude, Dr. Andrews determined to conduct one more experiment, in which he would set the ship free with full lift. In other words, he decided to throw out all of her ballast at once and see what she would do.

On August 6, 1863, he wrote to President Lincoln and to the Secretary of War, telling them what he had accomplished and what he planned to do next.

"I propose to make a last trial of her power and then to destroy her," he wrote. "She can be balanced only when she is full of gas, and that is hazardous after ascending to a sufficient height to be out of reach of bullets." And then came this almost pathetic plea for recognition: "Now all that I desire is that your Excellency will select some suitable person, the *(Continued on page 124)*

Send for FREE BOOK *"How to Obtain a* PATENT"

Delays may cost thousands in profits from your invention. "Little ideas may have big commercial possibilities,"—Protect them by Patents!

Our FREE Book gives complete information on how to patent your invention and get any profits it may make. The first person to record any idea has advantages over everyone else in obtaining a patent. So we send you free a "Record of Invention" blank, which when properly executed is proof of conception.

Established 1898—Strictest Secrecy

For 33 years we have practiced before the Patent Office and Federal Courts. Our long experience, our skilled staff of attorneys, our thousands of clients assure you of the kind of patent service you desire. Send for FREE book and blank today. Promptness may mean much to you.

MAIL COUPON NOW

VICTOR J. EVANS & CO.

Registered Patent Attorneys

New York Office, 223 Broadway

Chicago Office, 111 W. Washington St. | Philadelphia Office, 133 S. Broad St. | Pittsburgh Office, 501 Liberty Ave.

San Francisco Office, 582 Market St. | Los Angeles Office, 510 S. Spring St.

MAIN OFFICE: 603A Victor Bldg., Washington, D. C.

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" blank at once.

Name.....

Street & No.....

City..... State.....

INVENTIONS WANTED

Patented or unpatented. If you have an idea for sale, write HARTLEY'S Inc., Box 928-D, Bangor, Maine.

INVENTORS

who derive largest profits know and heed certain simple but vital facts *before* applying for Patents. Our book *Patent-Sense* gives those facts; sent *free*. Write **LACEY & LACEY**, 635 F St., N. W. Dept. 10, Washington, D. C. Established 1869

PATENTS

TO THE MAN WITH AN IDEA

Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request.

IRVING L. McCATHRAN, Patent Lawyer
Formerly with and successor to RICHARD B. OWEN
760 International Bldg., Washington, D. C.
41-D Park Row, New York City

TRADE-MARKS

UNPATENTED IDEAS CAN BE SOLD

I tell you how and help you make the sale. Free particulars. (Copyrighted)

Write W. T. Greene
921 Barrister Bldg. Washington, D. C.

Inventions Promoted

Patented or Unpatented. In business over 30 years. Send drawing and description or model, or write for information. Complete facilities. References.

ADAM FISHER MFG. CO.
183-D Enright St. Louis, Mo.

PATENTS—TRADE MARKS

All cases submitted given personal attention by members of the firm. Information and booklet free.
Patent Office and Federal Court Practice

Lancaster, Allwine & Rommel
Patent Law Offices
SUITE 413—815-15th St., N. W.,
WASHINGTON, D. C.

PATENTS SECURED

TRADE-MARKS REGISTERED

HIGH-CLASS Professional Service for Inventors and Trade-Mark Users is necessary for PROPER PROTECTION. **WE OFFER** you our facilities on Reasonable Terms. If you have an invention send us a model or sketch and description and we will give you Our OPINION whether your invention comes within the Provisions of the Patent Laws. Our Book, **"HOW TO GET YOUR PATENT"** and Record of Invention Certificate sent on request. **DELAYS are DANGEROUS in PATENT MATTERS.**

WE ASSIST OUR CLIENTS TO SELL THEIR PATENTS

TERMS REASONABLE **BEST REFERENCES**

WRITE TODAY

RANDOLPH & COMPANY, Patent Attorneys
Dept. 130 Washington, D. C.

Name .....

Address .....

Copyrighted material

Boys!
FLYING SCALE MODEL OF AN
AUTOGIRO
SENT TO YOU
FREE!

MAKE IT AND FLY IT YOURSELF!

Get It Now Free To You!

Enter Model Contests This Year With a Giro

Learn the wonders of aviation's newest and most unusual plane—Get it! Build it! Fly it!

You Don't Have to Buy It—You Get It Free!
You can't buy this autogiro—you get it FREE — compliments of the National Glider and Airplane News.

The Most Sensational Offer Ever Made
Never before such an offer as this—read coupon see what you get—act now if you want this Giro FREE.

MAIL THIS COUPON NOW!
National Glider and Airplane News,
Dept. P.S.J. 370—7th Ave., New York, N. Y.
Send me the National Glider and Airplane News monthly for 1 year; and the Model Autogiro complete Kit, Golden Wings and A. S. A. Membership Card, without extra charge. On arrival of the Kit I will pay postman $2.50 and the few cents postage charges. My money to be refunded if I am not delighted. ($3.50 in Canada and foreign countries.)
Name .....
Address .....
City ..... State .....
(Postage free if you prefer to send $2.50 with this coupon.)

Don't Be a Slave To a "Job"!

LEARN ELECTRICITY IN 90 DAYS Without Books

BY ACTUAL WORK

Why keep your nose on the grindstone in "just a job" at $35 or $40 a week all your life? Learn Electricity where opportunity is big and salaries run $50 a week and up! Train in 12 happy weeks at the Great Shops of Coyne. **No books.** All **Real,** practical work on **actual machinery. No previous experience or advanced education needed.** Experts work right with you every step of the way. *Enter any time.*

Electrical Refrigeration

Right now I'm including at no cost my big new **Electrical Refrigeration Course** to all who enroll for my electrical course. Write today for my big **Free book.** It tells you how thousands have made good with my training, and how many **Earn while Learning. Free lifetime employment service after graduation.** Mail the coupon today for all the facts.

COYNE ELECTRICAL SCHOOL
500 S. Paulina St. Dept. 12-73, Chicago

H. C. LEWIS, Pres., COYNE ELECTRICAL SCHOOL
500 S. Paulina Street, Dept. 12-73, Chicago, Ill.
Dear Mr. Lewis:
Without obligation please send me your Free Illustrated Book on Electricity and Coyne. Also special offer on Electrical Refrigeration.
Name .....
Address .....
City ..... *State* .....

REAL JOBS OPEN NOW FOR AUTO-AVIATION MECHANICS

AUTO and AVIATION MECHANICS, easily learned in 8 weeks through the McSweeny Shop-Plan method, is a specialized trade in a field where jobs are always open. Trained Auto and Aviation experts are NEEDED. Here you learn by actual work on real equipment with real tools. No books or lessons. Write TODAY for Big Free Book and Low Tuition offer. Act NOW.

McSWEENY SCHOOLS
Dept. A-6-1 **Cleveland, Ohio**

FLEW BEFORE WRIGHTS WERE BORN

(Continued from page 123)

more scientific and practical the better, and send him here that he may examine the machine and witness the trial."

He waited almost a month for a reply. When, on September 4, no answer had come from Washington, he made his test flight. That it was completely successful may be gathered from the first report of his activities ever to appear in print. On September 8, the New York *Herald* wrote:

"We have this week the pleasure to record the success of the most extraordinary invention of the age, if not the most so of any the world ever saw—at least the greatest stride in invention ever made by a single individual. . . On Friday, the 4th instant, he made his last experiment, and demonstrated to an admiring crowd the possibility of going against the wind, and of guiding her in any and every direction.

"After a few short flights, to satisfy himself and a few friends that all was right, he set her off in a spiral course upwards, she going at a rate of not less than 120 miles per hour, and describing circles in the air of more than one and one half miles in circumference. She made twenty revolutions before she entered the upper strata of clouds and was lost to view. . . In her upward flight could be distinctly seen her rapid movement in a contrary direction to the moving clouds, and as she came before the wind passing by them with great celerity. As she was distinctly seen thus to move both below and above the clouds on the clear blue sky at five o'clock, P.M., with the sun shining clear upon her, there could be no mistake or optical delusion to the beholder."

LACKING experience with high speeds, the reporter may be forgiven for erring on the side of exaggeration, though there can be no doubt that the ship was going at a considerable clip. No special knowledge, however, is required to observe whether a balloon goes with or against the wind, and the *Herald* article, therefore, is direct evidence that the ship moved independently of the wind and was under control.

The test cost the good doctor nearly $10,000, a tidy sum for any man to spend on an experiment. Surer than ever of the value of his machine for reconnaissance, Andrews went to Washington and succeeded in seeing Lincoln. The President was sufficiently interested to ask him to back up his assertions with statements from responsible observers.

Returning to Perth Amboy, Andrews forwarded letters from a number of prominent citizens. "She went upward and forward against the wind," said one, "then blowing from the north, not less than ten miles an hour. She minded her helm perfectly. He turned her around, came back to the place of starting, and came down to the ground."

ANOTHER witness wrote: "I saw him go up in his car, and navigate her, steer her by a rudder, and come down again. The direction of the wind seemed to have nothing to do with it. She went against the wind or in any other direction." A third testimonial said: "The Doctor sailed in any direction, either with, by, or against the wind, the wind blowing from ten to fifteen miles an hour. He steered her as easily as a sailboat. He went off against the wind, turned her around, and came back from where he started."

Proof positive, one would think, that the aereon more than justified her skipper's claims. What, then, was the reason for the President's inaction and apparent indifference? Lincoln never saw those letters. That helps explain why you never heard of Andrews and his airship until you read these pages. The War Department, it seems, had become thoroughly wearied of the Jersey inventor with his crazy idea of a dirigible balloon. A clique had been formed that blocked his every move.

Receiving no word from the President, the untiring inventor again went to Washington. There, in the files of the War Department, he saw the letters pigeonholed. Lincoln's secretary promised Andrews four times that he would place them on Lincoln's desk. He never did.

But Andrews was not easily beaten. He petitioned Congress for an examination of his invention. His requests were referred to the Military Affairs Committees of the Senate and the House. Evidently, the War Department again made its influence felt, for that was the last Andrews heard of them. Still, he did not give up. A statement of the situation was laid on the desk of each Senator and Representative.

THIS worked. Andrews was asked to give a demonstration of his invention, with rubber models, in the basement of the Capitol. As a result, the Military Affairs Committee of the House was sufficiently aroused to request the Secretary of War to appoint a commission to examine the invention and to report.

The commission, headed by Professor Joseph Henry, was appointed, and Dr. Andrews appeared before it. Its report was not only favorable, but recommended that Congress make an appropriation. But this report was not received by the House Committee until February, 1865, almost a year after it had been requested! By that time the War was so nearly over that there was no longer any need for a reconnoitering machine.

The approval of so able a man as Joseph Henry meant a good deal to Andrews. Braced by it, he set about organizing a company with the purpose of establishing an air transport line between New York and Philadelphia. A worse time for such an enterprise could not have been chosen. Few beside himself believed flight to be possible, while to the strictly religious the attempt was sacrilege. The War was scarcely over; reconstruction problems were becoming acute; business was upset.

THAT Andrews succeeded in forming a company at all is proof of his unwavering self-confidence and of the esteem in which he was held by those who knew him. Thirty-one men of substance and standing took shares in the enterprise.

In December, 1865, the company started in business, and a beginning was made with the building of a new aereon. The envelope was made of two balloons bought from the Government, and was eighty feet long, fifty feet wide, and thirty-six feet deep, with a capacity of 60,000 cubic feet. While the ship of 1863 had been too sleek and cranky, this erred the other way; it was too stubby. She was lemon shaped, with the top and bottom surfaces so rounded that there was not sufficient difference between resistance to vertical and that to forward motion. Nor did the "hang" of the basket afford enough control over the angle. With these faults, and a rudder inclined to jam, she had less flying ability than the earlier ship. Even so, she did well enough to elicit enthusiastic praise.

She was ready in May, 1866, and on the twenty-fifth, Andrews took her off from the 100-foot-square lot at Green and Houston Streets, New York, *(Continued on page 125)*

HE FLEW BEFORE THE WRIGHTS WERE BORN

(Continued from page 124)

where she had been built. A crash would have put the company out of business, for the three passengers that the doctor took up and the skipper himself, who was president, were its heads. The three first dirigible passengers were Dr. G. Waldo Hill, vice president; Charles M. Plumb, secretary, and George W. Trow, known to generations of New Yorkers as the publisher of Trow's City Directory.

But she did not crash. In a two-column article on May 28, the New York *World* was so specific as to leave little doubt about the quality of her performance. The ship, it said, rose to about 2,000 feet, and drifted until it was directly over Fourteenth Street and Fifth Avenue.

THE account continued: "Instantly the machine righted herself as ordered, and shot along at a rate that threw the astonished miles rapidly behind her. That course conclusively tested, the Aereon was headed due southeasterly, or directly against the wind. Changing her course, the gallant vessel, freighted with so many hopes, veered around as directed and, for five full minutes, whose luxurious duration seemed hours, she bore on her unswaying, undeviating way, with tremendous velocity, annihilating space, and spurning the wind across whose path she rode, and whose advancing hosts she met and conquered." Then came the words already quoted: "Navigation of the air was a fixed fact. The problem of the centuries had been solved." The trip ended with a safe landing at Astoria, L. I.

With a new rudder and other changes, there was a second flight on June 5. This time, Dr. Andrews took only one passenger, Mr. Plumb. The newspapers of the following day again reported the flight.

"The navigators," said the *Tribune*, "commenced to move in various directions and soon passed back again toward the north, going over almost precisely the same spot which they had just before crossed toward the south. That the balloon was not drifting with different currents of air was amply proved by the fact that the streamer attached to the car, instead of hanging down as in the case of an ordinary balloon, stood out from it in different directions as if blown by a strong wind. Sometimes this streamer pointed toward the head of the balloon, sometimes astern, and again toward either side, showing that the balloon was moving in a different direction from the air."

THE *Tribune's* then bitter rival, the *Herald*, was in full agreement. "Dr. Andrews turned the machine," it wrote, "and with a graceful motion came back against the wind, apparently having the machine under perfect control, and, having passed nearly over the place from which he started, moved off in the direction of Long Island."

These accounts are conclusive evidence that the Aereon actually traveled an out-and-return course with one leg against the wind, a feat previously accomplished only by Dr. Andrews' earlier ship.

The Aereon made a safe landing at Brookville, L. I. That flight was her last, for when the future seemed brightest and success most certain, a bank failure swept away the company's funds. With the organization in debt, the stockholders unwilling to make up the deficit, and the public completely apathetic, the company wound up its affairs.

Having demonstrated his principles, it was for someone else, Dr. Andrews felt, to develop and perfect them. But no one had caught the vision, and when he died a few years later his work was already forgotten.

Who else wants to learn to play....

at home without a teacher, in ½ the usual time and ⅓ the usual cost?

Over 600,000 folks have learned to play their favorite instruments the U. S. School of Music way!

That's a record that proves how *thorough*, how *easy* this famous method is.

Just think! You study in your own home and almost before you realize it you are playing real melodies from actual notes.

You simply can't go wrong. First you are *told* what to do. Then a picture *shows* you how to do it. Then you do it yourself and *hear* it.

Little theory—plenty of *accomplishment*. That's why students of the U. S. School course get ahead *twice as fast* as those who study by old-fashioned, plodding methods.

If you really want to learn to play at home—without a teacher—in one-half the usual time—and at one-third the usual cost—by all means send for the Free Explanation Booklet and Free Demonstration Lesson AT ONCE. No obligation. (Instruments supplied if desired—cash or credit.) U. S. SCHOOL OF MUSIC, 81 Brunswick Bldg., New York City.

LEARN TO PLAY BY NOTE

Piano — Violin
Guitar — Saxophone
Organ — Ukulele
Tenor Banjo
Hawaiian Guitar
Piano Accordion
or any other instrument

Fun—Popularity

You'll never know what good times are until you play some musical instrument. If you can play, many invitations come to you.

Never before have you had such a chance to become a musician without the drudgery and expense that were such drawbacks before.

U. S. SCHOOL OF MUSIC
81 Brunswick Bldg., New York City

Send me your amazing free book, "Music Lessons in your Own Home," with introduction by Dr. Frank Crane; also Free Demonstration Lesson. This does not put me under any obligation.

Name .....
Address .....
Instrument ..... Have you Instrument? .....

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make $5.00 to $15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
381 Fourth Ave. New York, N. Y.

FOR FIXIT SHOPS

FREE FOTO GUIDE and Vacuum Cleaner Parts Catalog. Most complete ever published. Lists over 800 items and special tools. 32 pages. Illustrated. Standard material at lowest cost. Valuable source data on obsolete parts. Big help to all repair shops.

WASHING MACHINE PARTS

Combined washer, vac, and small motor servicing attracts trade and reduces operating expense. We can supply most replacement parts. Uniformity to highest standards guaranteed. Lowest known prices with saving on transportation and trouble. Consolidated orders earn maximum discounts. Instructive catalog free.

Uron Associated Industries
1306 Engineers Bldg. Cleveland, Ohio

for **MORE PAY** *learn* **DRAFTING** From An ENGINEER

Practical Home training UNTIL IN POSITION. Salary paid Draftsmen $60 to $75 per week and up. I'll train a number of selected students on practical work as Draftsmen, or improve your present job to get a raise. I furnish you all tools and drawing table. Write for FREE PAY-RAISING Drafting Book.
ENGINEER DOBE, 1951 Lawrence Ave., Div. 13-61, Chicago

Get *your own* PATENTS

Why pay high attorney fees? Inventors have legal right to file their own claims. Our book clearly explains step by step how to prepare all necessary papers. Eliminate chances of theft; avoid delay; deal directly with the Patent Office. Pay government fees only—no attorney required. Legal blanks and book of complete instructions, $1.00 ("Making Patents Pay" $1. "How To Get Your Own Copyrights, Trade-Marks, etc." $1. Any two books, $1.75. All three $2.50.)

Address: CUTTING & SONS
Dept. 112 Campbell, Calif.

"The TRUTH about VOICE"

SENT FREE No Obligation to Buy

If you act quick!—we will send postpaid—for 30 days free reading—new Voice Book disclosing startling VOICE FACTS that may save hundreds of dollars to every man or woman seeking a strong, rich voice for either singing or speaking. 30 days free reading—then send $1.00. Otherwise, return it—that's all!

PROF. E. FEUCHTINGER Studio 13-61
308 North Michigan Avenue - Chicago

High School Course in 2 Years

You can complete this simplified High School Course at home inside of two years. Meets all requirements for entrance to college and the leading professions. This and thirty-six other practical courses are described in our Free Bulletin. Send for it TODAY.

AMERICAN SCHOOL
Dept. H-148 Drexel Av. & 58th St. © A.S. 1929 CHICAGO

CARTOON YOUR WAY TO SUCCESS!

DON'T COPY - LEARN TO ORIGINATE!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS at home that you can SELL! Course has 26 lessons and 600 illustrations. *Send name and address for free details.* Only **$2.85**

RAYE BURNS SCHOOL, 836 Lakeview Rd., D-8, Cleveland, Ohio

TRAVEL FOR "UNCLE SAM"

Railway Postal Clerks

Steady Work — No Layoffs — Paid Vacations
Many Other Government Jobs Obtainable
MEN—WOMEN 18 to 50

$158 to $225 a Month

MAIL COUPON BEFORE YOU LOSE IT

FRANKLIN INSTITUTE, Dept. K271
Rochester, N. Y.

Sirs: Rush to me without charge—copy of 32-page book, "How to Get U. S. Government Jobs," with list of positions obtainable and full particulars telling how to get a position.

Name .....
Address .....

"BACK IN 1903, I was a day laborer at the Camden Iron Works, Camden, N. J.

"I enrolled for the I. C. S. Sheet Metal Course, then, and today I am still directing the attention of ambitious young men to your courses. The main requisite to gain any degree of success in the world is to learn how to think. The I. C. S. system of teaching will do that for a man, if he will go along with it.

"Today my son is studying an I. C. S. course. It has benefited him in work at this shop."

Today Martin F. Leininger, who voluntarily recites his own experience, is superintendent of the Tiffin Art Metal Company at Tiffin, Ohio. Thousands of other men, all over the world, have also expressed their approval of I. C. S. *because of what it has done for them.* The I. C. S. students of today will be the superintendents of tomorrow! Mark and mail the coupon—today!

INTERNATIONAL CORRESPONDENCE SCHOOLS

"The Universal University"

Box 7602-G, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the subject *before* which I have marked X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect	☐ Bridge Engineer
☐ Architectural Draftsman	☐ Automobile Work
☐ Building Estimating	☐ Plumbing ☐ Steam Fitting
☐ Wood Millworking	☐ Heating ☐ Ventilation
☐ Concrete Builder	☐ Sanitary Engineer
☐ Contractor and Builder	☐ Sheet Metal Worker
☐ Structural Draftsman	☐ Steam Engineer
☐ Structural Engineer	☐ Marine Engineer
☐ Electrical Engineer	☐ Refrigeration
☐ Electric Wiring	☐ R. R. Locomotives
☐ Electric Lighting	☐ Air Brakes
☐ Welding, Electric and Gas	☐ Train Operation
☐ Telegraph Engineer	☐ R. R. Section Foreman
☐ Telephone Work	☐ R. R. Bridge and Building Foreman
☐ Mechanical Engineer	
☐ Mechanical Draftsman	☐ Chemistry ☐ Pharmacy
☐ Patternmaker ☐ Machinist	☐ Coal Mining Engineer
☐ Reading Shop Blueprints	☐ Navigation
☐ Civil Engineer	☐ Agriculture
☐ Highway Engineering	☐ Textile Overseer or Supt.
☐ Surveying and Mapping	☐ Cotton Manufacturing
☐ Gas Engines ☐ Toolmaker	☐ Woolen Manufacturing
☐ Diesel Engines	☐ Fruit Growing ☐ Radio
☐ Aviation Engines	☐ Poultry Farming

BUSINESS TRAINING COURSES

☐ Business Management	☐ Business Correspondence
☐ Industrial Management	☐ Lettering Show Cards
☐ Personnel Management	☐ Stenography and Typing
☐ Traffic Management	☐ Complete Commercial
☐ Accountancy	☐ English ☐ Signs
☐ Cost Accountant	☐ Civil Service
☐ C. P. Accountant	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Mail Carrier
☐ Secretarial Work	☐ Grade School Subjects
☐ Spanish ☐ French	☐ High School Subjects
☐ Salesmanship	☐ Illustrating ☐ Cartooning
☐ Advertising	☐ Lumber Dealer

Name ..... Age .....

Street Address .....

City ..... State .....

Occupation .....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

LearnAVIATION
WHERE LINDBERGH LEARNED!

Greater Demand for Mechanics!

20 Mechanics' jobs for every Pilot's job. GOOD PAY! Quick advancement! **But you must have proper training! Train at the world's best known Aviation school.** Lincoln graduates get best jobs—advance quicker—because of superior training. $250,000 worth of buildings and equipment. $100,000 airport. Government-licensed instructors. Mechanics' School connected with airplane factory—assuring **practical** training. **Ground and Flying School hold highest government approval.** Reasonable tuition. **FREE Aerial Radio Course** with other courses. Part time employment to help pay room and board. Also **Flying, Welding, Aerial Radio** Courses. Write for Catalog, stating age!

Lincoln Airplane & Flying School
215A Aircraft Bldg. Lincoln, Nebr.

GOLD FROM GARBAGE

(Continued from page 21)

rising on this land built of waste. Digging holes for the foundation pillars, the workmen found themselves getting hotter and hotter. Fifteen or twenty feet below the surface of the island they dug into a hidden fire. The heart of the entire island is believed to be on fire. The heat thus generated causes vegetables and flowers planted there to grow to unprecedented size.

How easily these hidden fires are started is sometime demonstrated by workers for the entertainment of visitors. A stick is driven three or four feet into the ground, after the top soil has been scraped away. Then water is poured into this hole. Within a few hours, smoke begins to rise from the hole and by nightfall the hole glows red as the eye of a dragon. This mass of material could not be improved upon for the purpose of generating fire if it were selected by a chemist. For one thing the dump contains much manure, lime, and potash; and varnish, linseed oil, and other ingredients of linoleum.

THESE hidden fires reduce the cubic contents of the dump and give to the remainder a solidity like that of ordinary land. Even a great mound of ashes will subside forty percent or more in the space of a half year; and if the dump contains paper and other rubbish the subsidence will be as much as sixty or seventy percent.

A great deal of this discarded material is exceedingly valuable. That is why a surprising number of men have found stuff worth millions of dollars in the ash and garbage cans of New York. Joe Marrone was one of these. Joe is dead now, but he died a millionaire after starting his career on a New York dump. Joe, and the men with whom he worked, salvaged the paper and cardboard from the rubbish that an endless line of trucks and wagons delivered at the dump. This reclaimed paper was then sent to mills to be made into new paper. Joe Marrone at last became a boss, then a contractor with the right to trim garbage and rubbish at all the city's dumps. Eventually he was an authentic millionaire, not just a rich man.

There are at least half a dozen fortunes in New York that were made by men who were not too proud to look for riches in the stuff others tossed away. Some of them made their money out of fat and bones and reclaimed string and rope. The fat was eventually tossed into great vats from which it emerged in the shape of bars of cheap brown soap. The bones were ground up into a rich fertilizer. Tin cans were melted down into window sash weights.

Thousands upon thousands of milk bottles are reclaimed from New York's rubbish every day. The milk companies have formed a reclaiming organization of their own, and this service saves not only bottles but countless forty-quart milk cans and boxes in which milk bottles are carried in the delivery wagons.

THESE objects find their way to the dumps because the men who collect trash in New York have no way of telling trash on the sidewalk from stuff not intended for the dump. It frequently happens that boxes of new merchandise are hauled away to the dumps from sidewalks and cellar areas. Recently about a dozen boxes of men's underwear, still in the wrappings in which they had left the factory, were carted to the dump.

Some months ago a frantic visitor to Riker's Island said he was in search of a $5,000 antique Persian rug. Somehow it had been carried out with rubbish from the service entrance of the building where he conducts his business. He had spent a day tracing that rubbish. The contractor whose trucks haul rubbish and ashes from that district had obliged him by identifying the particular wagon that had picked up the load. The load had been dumped with a dozen others onto a scow and the scow had been towed to Riker's Island. He even had the name of the scow.

"Yes," he was told, "we are about to unload that scow now."

He stood watchful as a terrier as the orange peel shovel deposited a couple of loads on one of the dump cars that represent the ultimate stage in the journey to the oblivion of the dump. Then a third shovelful was swung over the car, depositing a coating of dust on the unheeding rug dealer. As the contents cascaded to the pile on the car he gave a shout. He had seen his bundle. Half an hour later he was on his way back to the mainland, his rug in his arms.

One morning a dump inspector at an East Side scow loading dock saw a trimmer scrambling around on the top of the rubbish that had been piled aboard a scow the night before. A stiff breeze was fluttering the papers on the scow. The trimmer was picking up money! When he had discovered the last bill he had $400, and the only thing that troubled him was the thought of the other bills that must have blown overboard during the night.

WHO had lost that money and in what manner it had reached the waterfront dump are just two among many questions of the sort that must go unanswered. Hardly a man among the 15,500 employees of the Department of Sanitation but can relate some such adventure in treasure finding.

Another official of the department told me that when he was a dump inspector his attention was attracted one time by the peculiar actions of a scow trimmer. The man pretended to be shoveling with unusual ardor, but the inspector observed that he was pivoting on one leg in a curious manner. When the next truck load of rubbish was poured on the scow the man was directly in the way, but he held his position even though he was buried to his knees in trash. Then suddenly he reached down and snatched up an object upon which he had been standing. It was a flat package of $20 bills and there were ten of them.

Before the war a scow trimmer picked up some thin crisp sheets of paper that proved to be German marks, at a time when a mark was worth nearly as much as an American quarter, and there were 10,800 marks in the bundle.

Another time a scow trimmer snatched from the garbage on a moving belt a roll of bills partially burned. Some of the outside bills broke up into charred bits as he seized the roll, but even so he had $700 in his overalls when he left the job.

SOMETIMES dangerous objects come hurtling down the chutes where the rubbish scows are loaded. Hand grenades, shells, and other unsafe souvenirs of the war have been seen in those streams of litter that pour endlessly into the scows, bound out to sea or to Riker's Island. One cartman lost his sight when an earth-shaking explosion occurred as he emptied a can of rubbish into his cart in front of a bank. Chemists undertook to solve the mystery of that explosion as part of the task of determining who should compensate the cartman for the loss of his sight. They established that the explosion had been caused by the detonation of a bottle of picric acid. A janitor remembered that he had picked up a bottle containing some fluid at the rear door of the bank. Finally, it was established *(Continued on page 127)*

This One
9QN5-SUR-FQSQ

Copyrighted material

GOLD FROM GARBAGE

(Continued from page 126)

that the explosive had been left by bank robbers who probably had been frightened away before they could blow the safe.

There are plenty of other hazards connected with the work of housekeeping for a city. More men were killed in the service of the Department of Sanitation last year than in both the Police and Fire Departments. Ten were killed and 2,806 injured. One sweeper fell into the pit of an incinerator; one was drowned on one of those daily voyages to Riker's Island; some were struck by automobiles and others suffered fatal injuries while working on the big trucks.

There are eighteen scows called sea dumpers in service all the time and about fifty deck scows in the Riker's Island service. Each scow is manned by a captain and a mate. The scows that go to sea are towed to a point about twenty-five miles southeast of Scotland Light where there is deep water about midway off the coast of Long Island and New Jersey.

In a storm a couple of years ago one of those scows broke free from the towing line that held her to a tugboat. Several days later the scow was picked up by a ship nearly two hundred miles from New York, but the captain and the mate had vanished. Eventually a cablegram from Tampico, Mexico, said the captain and his mate had been landed there by an oil tanker.

AN AVERAGE of five of those sea dumpers are towed out into the Atlantic Ocean every day, but soon this huge depository is to be closed to the city by a decree of the United States Supreme Court. New Jersey recently won an action started in the Federal courts against the city when the Supreme Court upheld her contention that her beaches were being polluted by New York garbage that floated ashore.

Referees are engaged now in deciding just how long a time the city shall have to make other provision for the disposal of this waste.

Seventy percent of New York's garbage and forty-five percent of its rubbish is burned in twenty-two incinerators. Within a few years all of New York's rubbish and garbage will be burned but that will leave two problems of waste disposal—ashes and sewage.

Ashes are not so difficult. In normal times of building activity there is a healthy demand for ashes by building contractors. Usually a number of men flourish in New York by "scalping" ashes; that is, they send trucks scurrying about the business section ahead of the regular collection carts "stealing" the ashes that have been placed on the sidewalks.

THE ashes collected in this manner are sold for a dollar or more a cubic yard. Just now the ash scalpers have foresworn their trade because of the business depression, and in consequence the city is forced to find a dumping ground for more ashes than usual. In this year's budget, the city has had to provide $400,000 more than usual to dispose of ashes that ordinarily are taken off its hands by obliging scalpers.

The depression has worked other changes in this phase of municipal housekeeping. There is much less rubbish than usual, but so little of it is being reclaimed that the total number of scow loads is as great as ever. In periods of prosperity, about three quarters of the rubbish is reclaimed. How greatly the depression has affected the volume of rubbish and garbage is shown by the figures recorded at one dump in lower Manhattan. A little over a year ago 4,000 cubic yards of waste material were being unloaded there each day. This year the daily average is about 2,800 cubic yards. People may not be eating less but they are throwing less stuff away.

I will train you at home to fill a BIG PAY Radio Job

If you are earning a penny less than $50 a week send for my book of information on the opportunities in Radio. It is free. Clip the coupon NOW. Why be satisfied with $25, $30 or $40 a week for longer than the short time it takes to get ready for Radio?

Radio's growth opening many $50, $75, $100 a week jobs every year

In about ten years Radio has grown from a $2,000,000 to a $1,000,000,000 industry. Over 300,000 jobs have been created. Hundreds more are being opened every year by its continued growth. Men and young men with the right training—the kind of training I give you—are stepping into Radio at two and three times their former salaries.

You have many jobs to choose from

Broadcasting stations use engineers, operators, station managers and pay $1,200 to $5,000 a year. Manufacturers continually need testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $7,500 a year. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay $30 to $100 a week. There are many other opportunities, too.

Many N. R. I. men make $200 to $1,000 in spare time while learning

The day you enroll with me I'll show you how to do 28 jobs, common in most every neighborhood, for spare-time money. Throughout your course I send you information on servicing popular makes of sets; I give you the plans and ideas that are making $200 to $1,000 for hundreds of N. R. I. students in their spare time while studying. My course is famous as the one that pays for itself.

Talking Movies, Television, Aircraft Radio, Public Address Systems, are also included

Special training in Talking Movies, Television and home Television experiments, Radio's use in Aviation, Servicing and Merchandising Sets, Broadcasting, Commercial and Ship Stations, Public Address Systems are included. I am so sure that I can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lessons and Instruction Service upon completing.

Here's Proof

$100 a week

"My earnings in Radio are many times greater than I ever expected they would be when I enrolled. They seldom fall under $100 a week."
E. E. WINBORNE,
1267 W. 48th St.,
Norfolk, Va.

Jumped from $35 to $100 a week

"Before I entered Radio I was making $35 a week. Last week I earned $110 servicing and selling Radios. I owe my success to N. R. I."
J. A. VAUGHN,
3107 S. Grand Blvd.,
Grand Radio & Appliance Co.
St. Louis, Mo.

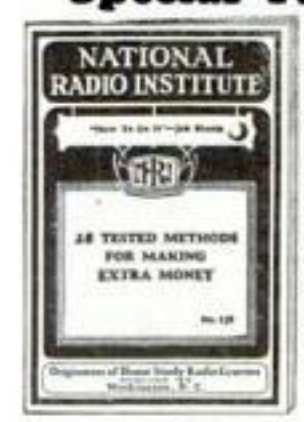
64-page book of information FREE

Get your copy today. It tells you where Radio's good jobs are, what they pay, tells you about my course, what others who have taken it are doing and making. Find out what Radio offers you, without the slightest obligation. ACT NOW.

J. E. SMITH, Pres.
National Radio Institute
Dept. 2AR3
Washington, D.C.

Lifetime Employment Service

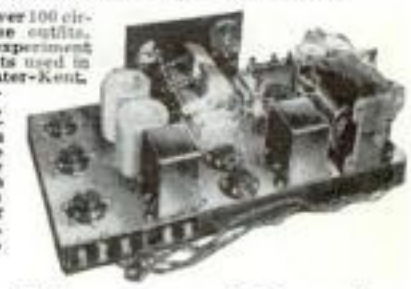
Special Free Offer



In addition to my big free book "Rich Rewards in Radio," I'll send you my valuable manual "28 Tested Methods for Making Extra Money." Never before available except to students. Now, for a limited time, it is free to readers of this magazine. How to make a good baffle for cone speakers, how to reduce hum in externally fed dynamic speakers, how to operate 25 cycle apparatus on 60 cycle current, how to operate 110v A. C. receivers on D. C., how to shield sets from local interference are five of the subjects covered. There are 23 others. Get this valuable book by mailing the coupon now.

.....You Get Extensive Practical Experience with the Outfits I Give You

You easily add over 100 circuits with these outfits. You build and experiment with the circuits used in Crosley, Atwater-Kent, Eveready, Majestic, Zenith, and other popular sets. You learn how these sets work, how to make them work. This makes learning at home easy, fascinating, practical.



I am doubling and tripling the salaries of many in one year and less. Find out about this quick way to BIGGER PAY

Radio Needs Trained Men

FILL OUT AND MAIL THIS COUPON TODAY

J. E. SMITH, President,
National Radio Institute,
Dept. 2AR3 Washington, D. C.

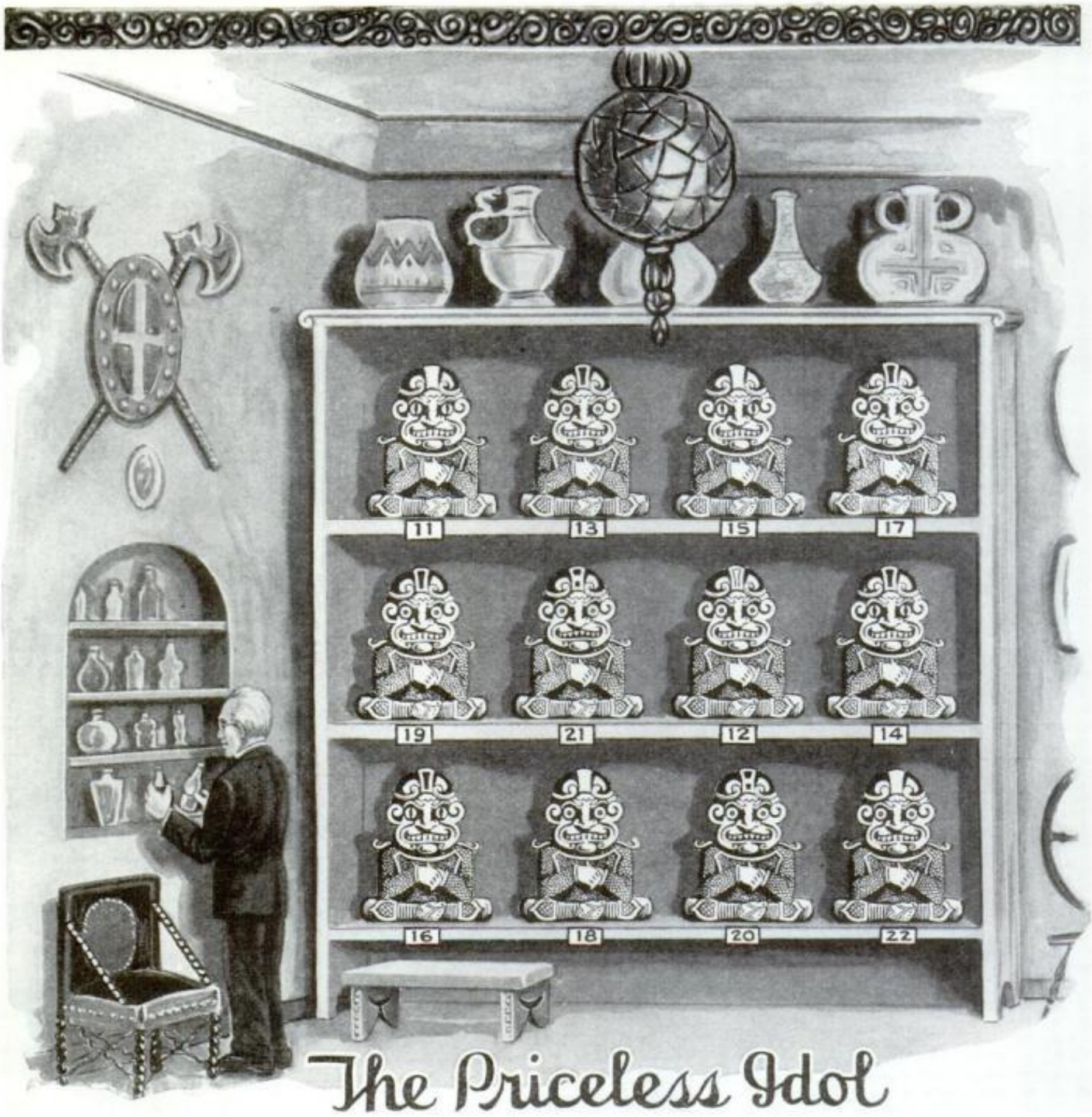
Dear Mr. Smith: Send me your two books "Rich Rewards in Radio" and "28 Tested Methods for Making Extra Money." This request does not obligate me and no salesman will call.

Name.....

Address.....

City.....State.....

Copyrighted material



The Priceless Idol

Qualify for the Opportunity to Win $2600.00

Unknown to the owner of the quaint curio shop pictured above there is among a number of idols he purchased an ancient and authentic idol worth thousands of dollars. The rest are merely imitations with imperfections, duplicated in other idols on the shelves.

Each of the 12 idols in the tier of shelves is fully visible. The imperfections are in the head dress, eyes or teeth, each imitation idol having one or more idol which is exactly like it. There is one and only one which is actually different from all the others. That is the priceless idol. Can you find it? It will take the keenest of observation!

60 Grand Prizes including prizes of $2600.00, $1300.00, $850.00, $700.00 and $600.00 in value will be given in our newest advertising offer. First prize will be $1600.00 cash or a Chrysler De Luxe eight-cylinder Sedan and $1000.00 will be added to the first prize on the proof of promptness, making a total of $2600.00. There is absolutely no charge to you for trying for these prizes which will be given in accordance with the contestants' standings when the final decision is made. You get $2600.00 if you are prompt and win first prize so be extremely careful in your answer for this opportunity.

Look carefully. If you can find the different idol lose no time, but send me the number under it in a letter or on a post card together with your name and address. Duplicate prizes will be given in case of ties and the prizes are all to be given free of all charge and prepaid. Answers will not be accepted from persons living outside U. S. A. or in Chicago. Send no money. There is no obligation BUT IF YOU CAN FIND THE PRICELESS IDOL RUSH YOUR SOLUTION TODAY TO

H. W. THOMSON, Advertising Director,
Dept. 97, 510 N. Dearborn St., Chicago, Illinois

Copyrighted material

Give a man a Gift he will Use!

Sure of a welcome, certain to summon a quick, appreciative smile from every man on your list—Williams Holiday Package. It's only a dollar, yes—but it's *the* great gift for men.

This cheerful, colorful gift-box contains five things that every man needs, every day. A big tube of Williams Shaving Cream—to keep his Face looking Fit. A bottle of bracy, fragrant Aqua Velva, the perfect finish for the perfect shave. A can of Williams Talc, of the color and lightness men like. A cake of toilet soap—his *personal* soap. And—he will thank you

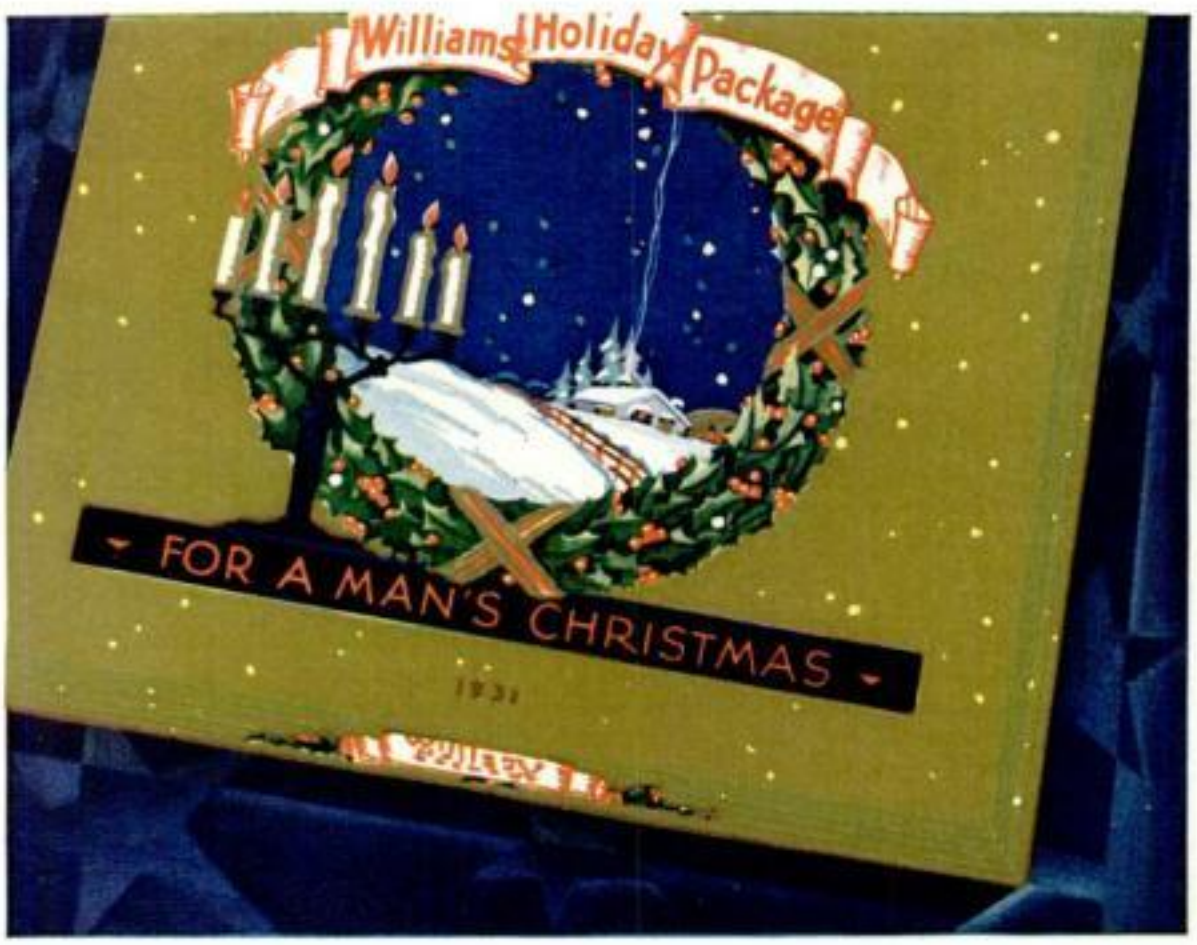
Williams Holiday Package

again when he sees this—a convenient safe for his razor blades . . . a place for *used* blades, and a storage place for *new* blades.

Here's Christmas in a package—a big, golden, generous package. You'll want three—six—ten or more of them for those names on your list. And you can get them wherever toilet goods are sold. Just say "Williams Holiday Package"—One Dollar.

THE J. B. WILLIAMS COMPANY
Glastonbury, Conn., U. S. A.
Montreal, Canada

$1.00



All men SHAVE. *Most men* PREFER *Williams.* EVERY *man will welcome this gay, golden gift. You'll need several Holiday Packages. Get them wherever toilet goods are sold.*

Copyrighted material

"That bully old slogan hits me just right—

. . . no bamboozlin' about that!"

SURE! When a word fits, you know it! "Satisfy" just *fits* CHESTERFIELD. A smoker picks up a package, and he likes its neat appearance—no heavy inks or odors from ink. *That* satisfies him.

Then he examines a Chesterfield. It is well-filled; it is neat in appearance; the paper is pure white. And that satisfies him.

He lights up. At the very first puff he likes the flavor and the rich aroma. He decides that it *tastes better*—neither raw nor over-sweet; just pleasing and satisfying . . . Then he learns it is milder. That's another way of saying that there is nothing irritating about it . . . And again he's *satisfied!*

Satisfy—they've *got* to satisfy! The right tobaccos, the CHESTERFIELD kind, cured and aged, blended and cross-blended, to a *taste* that's right. Everything that goes into CHESTERFIELD is the best that money can buy and that science knows about. CHESTERFIELDS do a *complete* job of it. *They Satisfy!*

© 1931, LIGGETT & MYERS TOBACCO CO.

Copyrighted material